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NOVEMBER 10, 1950



NATURAL COLOR PHOTOGRAPHY IN
COLLOIDAL SILVER

ROBERT D. BENSLEY

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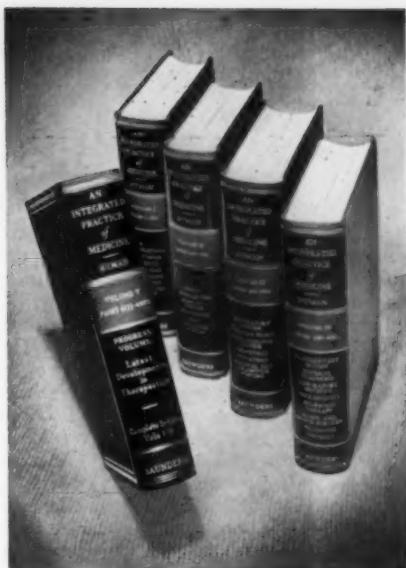
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SCIENCE, founded in 1880, is published each Friday by the American Association for the Advancement of Science at the Business Press, 10 McGovern Ave., Lancaster, Pa. Entered as second-class matter at the Post Office at Lancaster, Pa., January 13, 1948, under the Act of March 3, 1879. Acceptance for mailing at the special rate postage provided for in the Act of February 28, 1925, embodied in Paragraph (d-2) Section 34.40 P. L. & R. of 1948.

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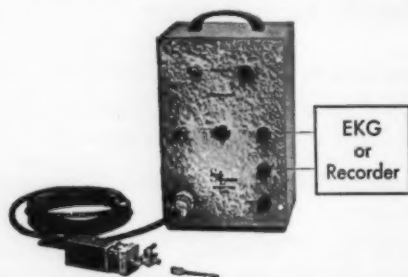
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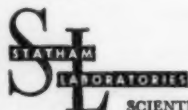
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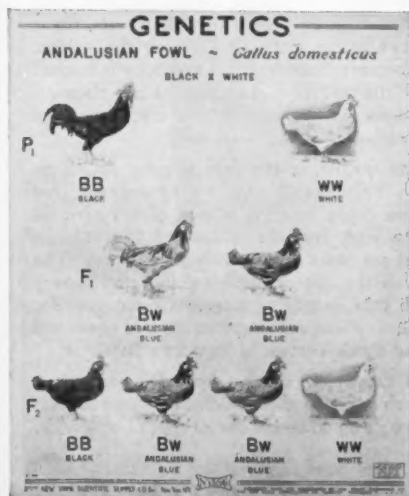


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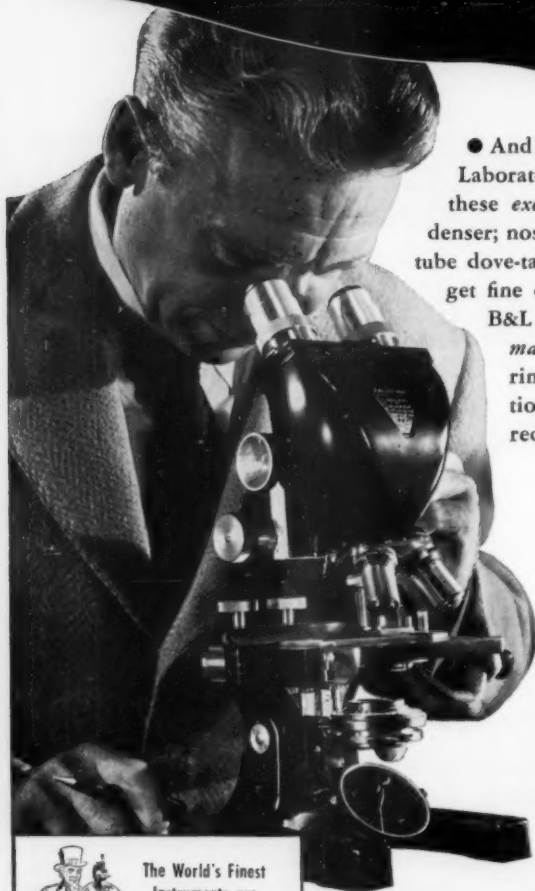
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Seebeck's discovery (1810), that the solar spectrum allowed to fall on a freshly prepared moist layer of silver chloride registered on the latter in colors closely corresponding to the colors of the spectrum itself, contained the promise of future direct color photography in reduced silver. After the discovery of the daguerrotype, much effort was expended in the attempt to realize a practical solution of the problem of color photography by this method. According to the testimony of contemporaries, some of the results were very beautiful; and Eder, in his *History of Photography*, mentions that he has in his possession such a photograph made by Niepce de St. Victor which had preserved its beauty for more than sixty years. Photographs made by this method, however, required a long exposure, could not be fixed, and had to be guarded with great care against exposure to strong light.

The production of color by development has for the most part been confined to the development of various

colors on slow, fine-grained plates, such as the Ilford Alpha Lantern plates, and various slow plates of other sorts. These plates, when given a normal exposure, developed a pleasing brown image; but, with longer exposures and restrained development, they produced various colors, culminating, with very long exposures, in red. One color, and one color only, was developed by any given exposure, whatever the range of densities of the negative from which the prints were made.

The only reference to the production of more than one color by development that I have been able to find in the literature is contained in a communication by A. Hoffmann, of Mehlen, published in *Photographische Industrie* and reproduced as a translation in the monthly supplement on color photography of the *British Journal of Photography* for August 1, 1924.³

This important communication failed to create any

¹ Hoffmann wrote:

When, by accident, the development of a number of landscape negatives had been carried far beyond the usual point, I made the observation that two of the plates showed strong natural colors in their central portions. When I came to trace the cause of this phenomenon, I made sure first of all as to the type of plate upon which this curious result had been obtained. It proved that the plates had come from a rather old packet of Guilleminot slow (silver chloride) lantern plates. In their development, a partially exhausted pyro developer, rich in bromide, was used. The plates were made with an unripened fine grain emulsion and had been washed in distilled water and packed in boxes for subsequent use. On account of the fact that the film side is not easily identified by the red light of the dark room lamp, my assistant had examined the plates for a few moments by the light of the lamp, so as to place them the correct way around in the dark slides. Consequently, the plates had had a certain small preliminary exposure.

Further experiments gave no results, and further experiments are therefore necessary. In these experiments the camera had been set up on one bank of a fairly large pond, and it was the reflection of the landscape in the surface of the water that had been rendered in its natural color. Since the light coming from the surface of the water was probably polarized, this explains why the color rendering faded from the axis out.

¹ The experiments recorded in this paper were carried out in the photographic laboratories of the Department of Anatomy of The University of Chicago. The writer wishes to express to the members of this department his appreciation of courtesies so graciously extended over many years.

² This is the substance of the results disclosed in U. S. Patent No. 2,473,131, granted to this writer on June 14, 1949.

enthusiasm in photographic circles, and one may assume that the experiment was tried by many others without success.

It is to be noted, however, that in these experiments of Hoffmann we find the same factor that appears again and again in the history of photochromy: namely, the favorable influence on color production of a previous exposure to diffuse light. Is it any wonder that Chapman Jones, summing up the results and prospects of this type of color photography, said in his book, *Photography of Today*, published in 1913: "There seems to be but the feeblest shadow of a foundation for the hope that such a method of color photography will ever be realized. . . . The success may be compared to the will-o'-the-wisp that lures the traveler onwards without helping him home." That this pessimistic forecast was not justified will be made apparent in the following pages.

PRELIMINARY EXPERIMENTS

Some years ago, I was engaged in investigation of the histology of the mammalian kidney and at the same time in experiments on high-resolution photomicrography, using for the latter purpose the Ilford Alpha Lantern plates sensitized to the longer light waves by being bathed in erythrosin and pinacyanol.

In the kidney investigation, I used an acid solution of silver citrate, with which I perfused the kidney from the aorta. After perfusion, the kidney was fixed in formalin, sections were cut, and the silver developed after exposure to light by a metol-quinol developer. In these preparations I found the lining cells of the blood vessels delineated in black silver as expected; but, in addition, there was a puzzling deposit of black granules along the surface of the tubules, doubtless caused by the precipitation of silver chloride at this point. Two possibilities were thus presented: that this was the real locus of the chlorides, or that the chlorides had moved to a new location because of differences in mobility between chloride and silver ions. The latter possibility could be tested experimentally.

Accordingly, I prepared a number of gelatin-coated plates by fixing lantern plates in sodium thiosulphate and washing them thoroughly. Some of the plates I immersed first in a solution of ammonium chloride and, after a brief rinsing, in a solution of silver nitrate. The chloride of silver was precipitated for the most part in the solution outside of the gelatin. When the experiment was reversed, however, and the plates were immersed first in the solution of silver nitrate and then in a solution of ammonium chloride, the silver chloride was deposited almost exclusively in the gelatin and the solution was almost free of deposited silver chloride. By this means I prepared

photographic plates of incredibly fine grain for high-resolution photography.

At the time these experiments were proceeding, the methods used for the screen plates of making positives by reversal were also being widely used in cinematography. The processors insisted that positives made by reversal were of much finer grain than the negative from which they were made. It occurred to me that the results would be still further improved if a new, practically grainless silver chloride were substituted for the residual halide of the usual reversal process. Accordingly, I prepared a rather thin negative of an outdoor scene, fixed it in thiosulphate solution, and thoroughly washed it. This plate was then impregnated with chloride of silver by the method indicated and the negative image removed by the usual bichromate sulphuric acid bleach. The new silver chloride was then developed in the usual way with a solution containing amidol and sodium sulphite. The result was most astonishing. Instead of the fine-grained positive that was expected, the plate flashed up in a number of colors, forming a combination negative-positive; for the negative that had been bleached redeveloped rapidly, adding a new group of colors to those resulting from development of the new halide.

This experiment was repeated many times with the same result. In addition, it was found that it made little difference whether the bleaching was done before or after rehaliding, or if it were omitted altogether. Indeed, every part of the process except the bathing in silver nitrate solution and development could be omitted, with little difference in the result.

In cases where the negative was bleached before rehaliding, an interesting phenomenon occurred. The silver chloride was taken up by the gelatin in inverse proportion to the densities of the silver removed. In other words, the gelatin adjacent to the silver particles was hardened or tanned during development proportionally to the amount of reduction product, and was less able to take up silver chloride than the other parts of the plate.

In these experiments the development was so rapid that it was difficult to observe the progress. Since silver chloride is freely soluble in solutions of sodium sulphite, the new silver halide was quickly removed. The development thus resolved itself into two stages. At first, chemical development proceeded for a brief period, followed by a period of physical development. In cases where the negative image had not been bleached, certain very interesting phenomena occurred. For example, a portion of the negative image, gray in color, would assume for a short time a fine blue color and then fade to a gray lighter than in the beginning. This indicated that there was not

only a fill-in of the portions of the negative not occupied by the negative image, but also a modification of the negative image itself. This change is undoubtedly of the nature of a Sabbattier reversal, though the conditions are somewhat different from those usually present.⁴ In this case the residual halide was removed by fixing in thiosulphate, and the plate was thoroughly washed and rehalided. This phenomenon doubtless requires further investigation, but in the meantime is of much importance, regardless of the explanation, in the production of the colors requiring a blue component.

These results, however fantastic they may appear at first sight, may be quickly verified by anyone having at his disposal a freshly developed gelatin plate which has been fixed in thiosulphate and thoroughly washed, and solutions of silver nitrate, ammonium chloride, and amidol sulphite developer.

It is obvious from the foregoing that any black-and-white photographic image, positive or negative, in a gelatin medium can be quickly transformed into a picture in many colors. The goal of photography in natural colors, however, has not been reached, although often negatives so reversed show an astonishing resemblance to the natural colors. An inspection of the results reveals that the colors obtained are strictly dependent on the densities of the negative treated. For example, zero density develops red, and the intermediate densities a series of colors trailing through the spectrum to blue and finally black. The problem is to produce such a distribution of densities that the colors will be correct and in the right places.

Obviously, this cannot be accomplished by a negative process. The problem of black intrudes as always, and black can only be achieved by a positive process. This constitutes the first limitation that must be met. Furthermore, since red must be black in the negative in order to print minus in the positive, a negative taken on a panchromatic plate is indicated. In order not to have the blue values too pronounced, this negative must be taken through a red filter.

The second limitation of the process at this point was the fact that the chemical development proceeded rapidly to completion, and desirable phases of color were very quickly passed. This difficulty was met by shifting to slow physical development.

The third obstacle to full natural color development was due to the fact that the screening provided by the silver already present and the differential rehaliding were not sufficient to produce the required colors. This difficulty was solved by exposing the rehalided

plate through a negative made on an orthochromatic plate through a yellow filter, or on a panchromatic plate through a blue-green filter.

Much research is still necessary fully to solve the problem, but sufficient success has been obtained to justify the hope that the solution will eventually be attained.

NATURAL COLOR PHOTOGRAPHS

For photographs in natural colors two negatives are necessary—one representing the values of the red end of the spectrum and the other those of the blue end. These negatives may be prepared in the case of stationary subjects by successive exposures through appropriate filters. Where movement is present, however, either a beam-splitter camera may be employed, or the negatives may be taken on a two-film pack such as Defender Dupae, designed for the two-color process.

The choice of filters is not an easy one, since not only must the color temperature of the light be considered but also the special properties of the emulsion employed. Much research is still necessary in this field to obtain the best results. Excellent results have been obtained under studio conditions with photoflood illumination, using an orthochromatic plate and a K1 filter for the blue-green negative, and a panchromatic plate and a Wratten 28 filter for the orange-red negative. Good results have also been obtained by using panchromatic plates for both negatives, with Wratten filters Nos. 28 and 40A, respectively.

In the descriptions which follow, the negatives are referred to as the blue-green negative and the orange-red negative, respectively. A lightly printed positive is made from the orange-red negative on positive stock, or preferably on a stock of longer scale and slightly larger grains, such as Eastman 33 or commercial film. This black-and-white positive is fixed in a nonhardening bath, such as

Sodium thiosulphate	300 g
Potassium metabisulphite	25 g
Distilled water	1,000 ml

for at least double the time necessary for the plate to look cleared. It is then washed in four changes of distilled water, 5 minutes for each change, and then for 1-2 hours in running water.

It is then resensitized. This resensitizing operation may be carried out as follows: First, the plate is immersed in a 1.7 percent solution of silver nitrate. I find it advantageous to confer a slight acidity on the solution by the addition of 0.36 g of citric acid per liter. The immersion in this solution lasts preferably for about 2 minutes, after which the film or plate is

⁴The Sabbattier reversal is produced by exposing the residual halide image of an unfixed negative to light and redeveloping. The result is a positive image.

rinsed for about 20 seconds and then immersed in a 10 percent solution of ammonium chloride for about 4 minutes. The plate is then thoroughly washed and dried.

The resulting plate is a black-and-white positive with a very fine-grained deposit of silver halide around, behind, and possibly even within the particles of silver in the plate. The plate may be handled readily in bright-yellow light. It is then matched in perfect register with the blue-green negative. While so held, the plate is exposed through this blue-green negative. This exposure is close to a crash exposure. (It is my practice to test the transmission of the blue-green negative with a photoelectric exposure meter, using a photoflood light and moving the negative back until the transmission registers 10 foot-candles. The blue-green negative is then matched in register with the orange-red positive plate and given an exposure, at the predetermined distance, of 30-35 seconds.)

During this exposure, the sensitive silver halide is screened not only by the blue-green negative, but also by the reduced silver in the positive already present. Thus, those portions of the image that were clear in the negative will be black in the positive, and the amount of new silver halide will be relatively small. On the other hand, the dark portions of the negative will be light in the positive, and so take up a large amount of silver chloride.

The result, it will be noted, accentuates greatly the differentiation between the red and blue values of the picture. That is, the red portions are light, they have a maximum of new silver chloride, and they also are exposed through the lightest portions of the blue-green negative. On the other hand, blue portions are dark in the positive, they have a minimum of resensitized material, and they are exposed through the darkest portions of the blue-green negative.

The plate is then developed in a suitable developer, such as

Glycine (<i>p</i> -hydroxyphenylglycine)	1 g
Sodium sulphite	10 g
Distilled water	100 ml.

At time of using, add 2 ml of 1.7 percent silver nitrate. This is a slow physical developer that takes some time to develop, but in due course the image on the plate will gradually change to an image in full natural colors. This development may also be accomplished by highly restrained chemical developers. The glycine developer quickly removes all silver chloride from the plate. When this is done, the room lights should be turned on so that the development may be judged by vision. At this stage the glycine developer can be replaced by a stronger physical developer, such as Odell's formula, and development time thus reduced

to a few minutes.⁵ The finished color picture must be fixed 5 minutes in thiosulphate solution, washed thoroughly, and dried.

During development, those portions of the final picture that are to be red pass through a series of transformations ranging from canary yellow through orange, gradually merging into red. The yellow portions begin to show a hint of yellow color about the time the red portions are orange and then become fully yellow at about the time that the reds reach their proper color, although the yellow lags slightly behind the red. The greens do not begin to show color until the reds are verging on red, at which time the greens begin to show traces of yellow and then become green. The blues are, of course, dark in the positive from the orange-red negative, and they change to blue late in the development.

If this process is carried out faithfully and with proper exercise of judgment gained from experience, the results are truly amazing. A print is obtained in full color and of high transparency.

It should be emphasized at this point that this is not just another two-color process in the ordinary sense. The purpose of the filters is to so balance the densities of the two negatives that, by interaction of the silver deposit in the first print from the one negative with the new silver resulting from exposure through the other, the appropriate colors may be produced. For example, in one experiment a colored print of a young girl wearing a blue dress was photographed through red and green tricolor filters, and the delicate blue of the dress was reproduced perfectly notwithstanding the fact that neither filter transmitted any blue light.

Moreover, any negative or positive can be transformed into a many-colored product simply by rehaliding, exposing to light, and redeveloping as described. For example, an x-ray photograph can be transformed into a colored product with a variety of colors representing the various densities. Two photomicrographs taken with different wavelengths of monochromatic light can be combined in a colored picture representing in different colors the specific areas of transmission.

To produce photographs in natural colors, it is necessary not so much to register the color values as to produce a pair of negatives with the densities so balanced as to be capable of producing a print in natural colors; to produce from one of these nega-

⁵ To make up Odell's formula, proceed as follows: Dissolve 50 g of anhydrous sodium sulphite in 250 ml of distilled water; dissolve 8 g of silver nitrate in 200 ml of distilled water; add the silver nitrate to the sodium sulphite slowly, with continuous stirring, the white precipitate formed being redissolved in the excess of sodium sulphite. When the solution is clear, add 80 g of anhydrous sodium thiosulphate. The above is a stock solution. The working developer is made by diluting 15 ml of this stock solution with 85 ml of distilled water and adding .25 g of amidol.

tives a print of proper density; to rehalide this print as described; to expose it behind the second negative; and to develop it to the proper grade of color. Study of the properties of the negative materials and of the color temperature of the illuminant is required, as is a selection of suitable filters.

There are certain aspects of the process that a beginner should keep in mind:

1. It is good practice to wash all plates or films to be processed in distilled water, in order to prevent double salts of sodium and silver thiosulphate from being carried over to react with lime salts in tap water.

2. The final development should be closely watched until the desired colors are obtained and then promptly stopped by immersion in strong hypo solution. The plate should then be thoroughly washed and dried. If the development is carried too far, the colors may change materially on drying and the reds may even become blue. Such a result is probably due to underexposure and overdevelopment. If, however, the whites display a light-yellow fog, overexposure is indicated.

3. White fog throughout the gelatin may be due to insufficient washing in distilled water.

To the amateur or professional worker this process presents obvious advantages:

- a) The negative materials are available at all places where photographic supplies are sold. They are the ordinary supplies of commerce.

- b) The detail is much clearer, since the outlines of objects are not diffused, as in the dye-toning and dye-coupling processes, by extension of the reaction.

- c) Any number of color positives desired can be prepared from a single pair of negatives.

- d) The pictures are permanent.

- e) All silver may be removed from colored pictures made by this process by treatment with ferricyanide and thiosulphate until only clear gelatin is left. The picture may then be redeveloped physically in full color.

A question of deep interest is: How are these colors produced? It is easy to understand the source of yellow, orange, and red. But how can we account for the production of blues, greens, browns, and other colors that require a blue component, and also for all the variants of red, which appear in the finished product? In my patent application I left this question undecided, but I have done much experimentation since, and I have come to the conclusion that the finished picture is reached not merely by the addition of highly dispersed silver to the positive print already present but also by progressive change in this positive itself.

There are many grounds for this conclusion. Herschel reported that in repeating the Seebeck experiment he found that the red portion of the spectrum reduced a deposit of silver already present owing to exposure to diffuse daylight. This Herschel effect forecast the well-known Sabattier effect. In my own experience in reversing a negative by the process of rehaliding, exposing, and chemical development, I have frequently seen a patch of gray in the negative pass through a brilliant blue phase in development. Also, a positive or negative completely removed by ferricyanide and weak thiosulphate may be redeveloped physically, in which case the image passes through yellow, orange, red, and blue to black. Obviously, a reduction to the proper degree would reproduce blue. This interpretation would also explain why, in my process, green develops without passing through a blue phase. In this instance, the reduction of the old silver and the development of the new yellow silver proceed hand in hand.

Obviously, if the foregoing is true, the character of the silver deposit in the primary positive is of much importance, since a spongy type of black grain would be much more likely to display the Sabattier effect than the more solid gray type of grain. This is a field in which much more investigation is indicated. The qualities of the gelatin matrix and the degree to which it is tanned by the first exposure and development are also important.

The nature of the silver colors produced is still obscure, although there are many adherents to the theory of Chapman Jones that the color transmitted is determined by the size of the silver particles. With the wide range of colors which it is now possible to produce by the method here disclosed, an interesting field of research is opened up.

Another interesting question also presents itself. Can a film be prepared which would combine in a single medium the properties required to produce a black-and-white positive after exposure behind the orange-red negative and, following adequate washing and drying, give a colored result after a second exposure of the blue-green negative? I have given much attention to this, and my answer is unequivocally yes. I have produced excellent colored prints on certain chlorobromide plates and on gaslight papers with good coincident rendering of gray scale and color patches. The medium was first exposed behind the orange-red negative. After development, the process was quick-stopped with dilute acetic acid and the print thoroughly washed and dried. It was then given an exposure of suitable length, after accurate matching behind the blue-green negative, and developed.

Technical Papers

The Mechanism of Clot Retraction¹

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Since there is clinical evidence that clot retraction may be a causal factor in venous thrombosis and pulmonary embolisms (1), it becomes desirable to consider the agents that influence this specific and characteristic property of the fibrin clot. It has been known since the time of Hayem that clot retraction requires intact platelets (2). Recently it was shown, in confirmation of older studies, that the speed and completeness of retraction are quantitatively influenced by the number of platelets (3).

In order to ascertain what other factors play a role in retraction, a system was devised consisting of washed fresh platelets suspended in purified fibrinogen to which thrombin was added. From the fact that clot retraction occurs with only these three agents present, one can conclude that the intrinsic factors that influence this behavior of the clot are the concentrations of thrombin and fibrinogen and the number of fresh intact platelets.

In the experiment presented in Fig. 1, the concentra-

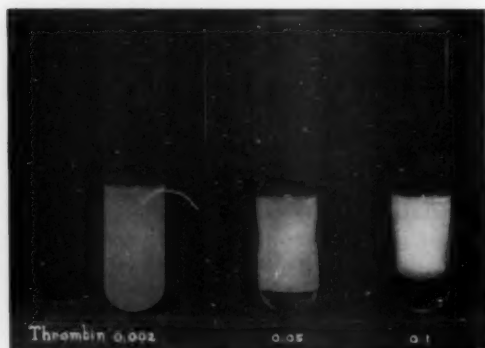


FIG. 1. Influence of thrombin on clot retraction. Washed human platelets were suspended in purified fibrinogen solution. Thrombin was prepared according to the directions of Quick (4).

tion of fibrinogen and the number of platelets were maintained constant, but the concentration of thrombin was varied. It was found that when the concentration of thrombin is very small, coagulation is slow but complete. No retraction, however, occurs. As the amount of thrombin is increased, retraction becomes progressively more complete but finally reaches a fixed maximum, which

¹ This work was supported by a grant from the Division of Research Grants, National Institutes of Health, USPHS.

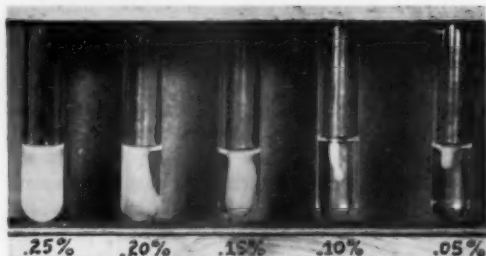


FIG. 2. Effect of the concentration of fibrinogen on clot retraction. The fibrinogen (bovine) was supplied by Armour & Company. The platelet count was 30,000/mm, and the amount of thrombin added to each tube was 0.1 cc.

depends on the concentration of fibrinogen and the number of platelets.

To study the influence of the concentration of fibrinogen on clot retraction, a constant amount of thrombin was added to a series of test tubes containing a fixed number of platelets, but a varying concentration of fibrinogen ranging from 0.25% (the average level of normal plasma) to 0.05%. It can be concluded from inspecting Fig. 2 that the smaller the concentration of fibrinogen, the more compact is the clot. The relation of contraction to the concentration of fibrinogen is not linear. Retraction diminishes rapidly as the amount of fibrinogen is increased, and in tube No. 1 scarcely any serum is expressed.

A logical explanation for these results can be offered. Platelets in the complete absence of thrombin remain discrete, show no stickiness, and do not adhere to foreign surfaces. When platelets come in contact with thrombin, they undergo morphological changes, become sticky and agglutinate, as Fonio (4) and, more recently, Zatti (5) have reported. It has long been known that fibrin adsorbs thrombin, and therefore it can be concluded that, if the amount of thrombin is sufficient, the strands of fibrin will be coated with a layer of this agent. Platelets coming into contact with this surface will adhere to the fibrin strands and then undergo metamorphosis, which apparently affects the fibrin strands in such a way that shortening and contraction of the fibrin reticulum result. It follows, therefore, that the higher the number of platelets and the greater the concentration of thrombin in relation to the quantity of fibrinogen, the more complete will be the retraction of the clot. The fibrin strand by itself has no power to retract. It becomes necessary to differentiate between syneresis, which is the contraction of a colloidal gel, and clot retraction, which occurs when a crystalline or a quasi-crystalline structure, the fibrin reticulum, undergoes physiochemical changes as a result of the action of thrombin and platelets attached to the fibrin.

Clot retraction is a relatively weak force that is af-

affected extrinsically by various factors. The two most important are (1) the affinity of fibrin for the walls of the container and (2) the cell volume. Thus, normal blood will show clot retraction in a glass test tube, but not in a collodion-coated tube (6). Presumably, fibrin becomes more firmly attached to a collodion than to a glass surface. Since the erythrocytes and leucocytes are nonecompressible, it follows that the greater the cell volume, the less will be the clot retraction. Retraction is generally marked in anemic blood and almost absent in polycythemic blood. The clinical significance of these observations has been discussed elsewhere (7).

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The Adrenal Gland and Hemopoiesis¹

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Accumulating evidence indicates convincingly that the endocrine gland system exerts a regulatory influence on certain phases of blood formation and destruction in the vertebrate organism (1, 2). The glands that appear to be implicated in these processes include the pituitary, thyroid, gonads, and adrenal. More recently, considerable attention has been focused on the effects produced by adrenal cortical factors upon the white blood cell elements (3, 4, 5). A decrease in the circulating lymphocytic and eosinophilic levels has now become recognized as a sensitive indicator of the presence of extra quantities of adrenal cortical or adrenocorticotrophic factors in the blood stream (3, 6, 7). Although some data have appeared on the manner whereby the cortical hormones influence lymphocytic numbers in the peripheral blood (8, 9), only fragmentary information is available concerning the mechanism by which they affect the granulocytic and erythrocytic levels and, more particularly, concerning their effects on the site of blood formation, the bone marrow. The need for such information and, in addition, the current application of the adrenal cortical factors in the treatment of myelogenous leukemia (10) make important an experimental investigation of the effects of chronic adrenal insufficiency and replacement therapy on the hemopoietic processes. This report describes some preliminary results obtained in one phase of this research.

¹ This work was aided by a grant from the Daxian Foundation for Medical Research.

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TABLE 1
EFFECTS OF ADRENALECTOMY AND REPLACEMENT THERAPY
UPON BONE MARROW CELLULAR PERCENTAGES
(MEAN \pm STANDARD ERROR)

Elements*	Controls (14)†	Adrenalectomized (8)	Adrenalectomized + Compound E, 0.5 mg (4)	Adrenalectomized + Compound E, 1.0 mg (4)
Blasts	1.6 \pm 0.1	3.2 \pm 0.5	0.8 \pm 0.2	0.8 \pm 0.1
Neutrophils				
Promyelocytes and myelocytes	10.9 \pm 0.6	17.1 \pm 1.1	6.6 \pm 1.0	6.3 \pm 1.3
Metamyelocytes and segmenters	21.1 \pm 1.4	24.6 \pm 0.7	36.1 \pm 1.8	39.4 \pm 4.5
Eosinophils (all forms)	9.1 \pm 0.8	14.2 \pm 0.8	9.0 \pm 1.8	8.2 \pm 2.5
Total granulocytes	41.6 \pm 2.4	55.9 \pm 1.8	51.6 \pm 4.3	53.7 \pm 6.7
Nucleated erythrocytes	56.5 \pm 2.1	40.5 \pm 2.2	47.5 \pm 4.2	43.7 \pm 4.9
Erythrocytes/myelocytes	1.46 \pm 0.1	0.73 \pm 0.1	0.96 \pm 0.2	0.85 \pm 0.2

* Lymphoid cell elements, which are not included in the myelograms, were not affected by the experimental treatments and did not exceed 2% of the total population in the control or adrenalectomized animals of the particular strain of rats employed.

† Numbers of animals employed are given in parentheses. All adrenalectomized animals were observed and treated for a 2-week period beginning with the first day of operation.

Groups of young adult female rats of a hardy, closely inbred strain, weighing 140-170 g, were adrenalectomized and maintained on 1% sodium chloride given as drinking water. Eight of the 14 controls were sham-operated and injected with 1-2 ml of 1% saline daily.

The peripheral blood of the adrenalectomized rat is characterized by the development of an anemia that attains its maximum (20-25% below normal) 2-3 weeks after the operation. The red cell counts and hemoglobin tend to rise following this time, but normal values are not reached up to 8 weeks subsequent to the operation. These results are in agreement with the data reported by Crafts (11). Associated with the anemia is an increased resistance of the red cells toward hypotonic saline. Their decreased fragility attains its maximum at about the time the anemia has reached its peak. No significant alterations in the peripheral total white cell and differential counts were observed during the experimental period.

All animals were killed by exsanguination, and marrow cell counts made from combined femoral and tibial marrows suspended in homologous serum and Giemsa-stained. A total of 1,500 nucleated cells was counted for each animal by use of the method of classification suggested by Endicott and Ott (12). It will be seen from Table 1 that 2 weeks after the adrenalectomy there occurs a rise in the percentages of total granulocytes in the marrow. The increase is due to significant elevations in the percentages of all myeloid components, including blasts,

eosinophilic, and young and mature neutrophilic elements. These changes are accompanied by a significant diminution in the percentages of nucleated erythroid elements, with a consequent decrease in the values of the erythroid-myeloid cell ratios, as compared with the untreated and sham-operated controls.

Administration of whole adrenal cortical extract³ (1-2 ml daily) to adrenalectomized rats, beginning with the first day of operation, although effective in preventing the development of the peripheral anemia and increased red cell resistance, is without significant influence upon the marrow components, except for a concomitant decrease in the percentages of blast cells. Table 1, however, indicates that Compound E (17-hydroxy-11-dehydrocorticosterone acetate⁴), in dosages of 0.5-1.0 mg daily, is partly effective in restoring the bone marrow myelograms to normal values. This substance significantly reduces the degree of myeloid immaturity, and the most significant decreases occur in the eosinophilic and young neutrophilic cell groups, with accompanying increases in the percentages of mature neutrophilic forms. Erythroid-myeloid cell ratios are increased, but completely normal values are not obtained with these dosages of hormone. Significant decreases in the eosinophilic levels of the peripheral blood are also observed when this hormone is given to the adrenalectomized animal.

It is thus apparent that the marrow of the adrenalectomized rat is characterized by increased percentages of myeloid elements, associated with elevated levels of eosinophilic and young neutrophilic forms, tending toward a leukemoid state. The decreased nucleated erythroid cell percentages could account for the peripheral anemia that develops in the salt-maintained adrenalectomized animal. Despite the changes that occur in the granulocytic percentages in the marrow, however, no consistent trends were observed in the peripheral white cell picture with chronic adrenal insufficiency. It should be borne in mind that peripheral blood cell values may be influenced by a variety of processes, of which type and rate of cell production are only two. A complete elucidation of the question as to how the adrenal cortex influences the numbers of circulating blood cells can be achieved only after the effects of adrenal insufficiency and replacement therapy are studied in connection with such additional factors as total functional marrow mass, rate of release of cells from the marrow, longevity of the cells in the circulation, and possible redistribution of the cells to other organs.

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³ We are indebted to D. A. McGinty, Parke, Davis & Co. for generous supplies of the cortical extract Eschatin (Compound E content, 164 µg/ml).

⁴ Compound E acetate (cortisone acetate) was supplied through the kindness of Harry J. Robinson and Augustus Gibson, Merck & Co., Inc.

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Modified Laboratory Lyophil Apparatus

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A modification of the lyophil apparatus of Holzman (2) has been in use in this laboratory for several months and has been free from one objectionable feature of the original design. The ring seal at the top of Holzman's apparatus is a point of weakness, since any movement of the center tube will cause breakage, even though this tube is supported on glass pins.

Our apparatus replaces the sealed-in center tube with a female standard taper joint, so that the body of the apparatus consists of six 34/45 female joints arranged symmetrically and at right angles to each other (Fig. 1).

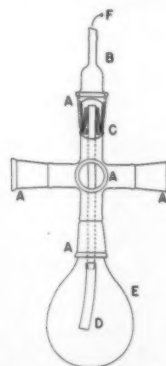


FIG. 1. Lyophil apparatus, side view: A, ports, ST 34/45 female, for flasks; B, exhaust tube, ST 34/45 male; C, cork insert in exhaust tube; D, removable glass center tube with flexible end (Tygon) extending into receiver flask; E, receiver constructed from 800-ml Kjeldahl flask; and F, connection to vacuum.

A male joint is drawn and sealed to 10-mm glass tubing, and the center tube of the same diameter is inserted through a cork in the lower end of this joint. It is not necessary to achieve a completely gas-tight seal by insertion of the cork, as there is no restriction on gas flow through the center tube, the purpose of the latter being

to direct the atmosphere through the trap flask during the early stages of evacuation. This assembly is inserted through the top female joint of the body.

The operation and efficiency of this modification are as described by Holzman. The advantages are a more rugged structure and a simpler construction.

As pointed out by Campbell and Pressman (1), it is convenient to stopper unused ports of the apparatus with sealed-off standard tapers, which may also be used for drying small samples of material.

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Sulfapyrazine Precipitated in Cancer Tissue upon Repeated Glucose Injections¹

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Cancer tissue, unlike most normal tissues, produces large quantities of lactic acid aerobically. The acid production can be increased by intraperitoneal injection of glucose to the point that the pH of the extracellular fluid often drops below 6.4, as measured by glass electrode (1). This fact has enabled us to produce high local concentration in cancer tissue of a compound administered at a site distant from the tumor. The compound used, sulfapyrazine, was precipitated in the tumor presumably because it is less soluble at acid pH than at pH 7.4. Rats with Walker tumor 256 were used.³

As an example we give the concentrations of sulfapyrazine found in 2 implants of tumor 256 and in other tissues taken from a 400-g rat injected 3 days earlier with sulfapyrazine. The tumors were subcutaneous in the interscapular region. When they were 16 days old, the rat was given a single subcutaneous injection in the hind leg of 55% aqueous sodium sulfapyrazine containing 0.5 g of sulfapyrazine. During the 3-day period 14 g of glucose were given intraperitoneally in 50% solution. The rat was then killed by bleeding under ether anesthesia. The tumors were flecked with white precipitate and were necrotic throughout. Tissues were weighed, digested in alkali, aliquots were precipitated with *p*-toluenesulfonic

¹ Preliminary report. This work was supported by grants from the National Institutes of Health, Public Health Service, the Damon Runyon Memorial Fund, and Mead Johnson & Co. Sulfapyrazine was supplied through the courtesy of R. C. Ellingson, of Mead Johnson & Co.

² We are indebted to Gustav Eckstein for his assistance and encouragement in this work, to Martin Fischer for laboratory facilities, and to Paul H. Stewart, Paul R. Henry, and Louis Soffer for technical assistance in the early stages of the work.

³ Tumor supplied through the courtesy of John B. Storer, Department of Pathology, University of Chicago.

acid, and the sulfapyrazine was determined colorimetrically by the Bratton and Marshall technique (2).

Serum taken from the heart at sacrifice contained 87 mg of sulfapyrazine/100 ml, the blood 93% as much, the small tumor (4.5 g) 330%, the large tumor (6.6 g) 280%, kidneys 100%, stomach (without forestomach) 95%, hide 94%, small intestine (upper 8 cm) 83%, heart 73%, lungs 72%, liver 69%, spleen 61%, leg muscle 55%, and testes 54%.

TABLE 1

DATA ON 250 RATS WITH WALKER TUMOR 256 KILLED AFTER SUBCUTANEOUS INJECTION OF SULFAPYRAZINE

Mg of sulfa injected/100 g body weight	Hours between sulfa injection and killing	Sulfa/g of tumor divided by sulfa/ml of serum		Sulfa/g of kidney divided by sulfa/ml of serum	
		> 1	< 1	> 1	< 1
		No. rats	Chi square ^a	No. rats	Chi square ^a
Repeated injections of glucose					
100-200	20-37	31	14	64	9
Single injection of glucose					
200-1,000	3-20	26	79	27	31
No glucose injected					
200-1,000	3-20	29	71	18	75
				25	25

^a All probabilities are less than 0.01 except for the smallest chi square, of which the probability is between 0.01 and 0.02.

Table 1 illustrates conditions in which similar concentration of sulfapyrazine in tumors did and did not occur. Highest concentrations were found in necrotic tissue. The quantities injected are generally lethal. The tumors had a median weight of 1.28% of the body weight, none more than 13%.

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Measurement of the Extract of Cornstalks

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By extract is meant the water-soluble content in terms of the Brix sugar scale (3). In its measurement the assumption is made that the water, as well as the soluble solids, is uniformly distributed throughout the sample. It is necessary to know the total moisture content, and the Brix reading of the juice at or near 20° C. If sufficient juice cannot be obtained, a known amount of water is mixed with the sample, the diluted juice is expressed, and its Brix reading measured. The method is rapid, does not require expensive equipment, and is far more easily operated than any of the other sugar estimation methods. Clark (1) has found that approximately two-

SHOWING EXTRACT OF MATURE CORNSTALK

Sample No.	Dry weight, % of fresh weight	Total water, g	Brix, corr. to 20° C	Extract, % of dry weight	Extract, % of stalks
1	22.0	297	2.11	21.3	4.69
2	26.53	326	4.28	48.6	12.86
3	18.68	294	3.57	35.9	6.71
4	15.36	297	2.38	24.1	3.70
5	32.77	295	2.08	20.9	6.85
6	28.21	330	3.28	37.3	11.52
7	23.36	306	3.68	39.0	10.52
8	24.06	305	3.03	31.8	7.65
9	32.83	305	4.88	52.1	17.10
10	28.18	303	3.98	39.9	11.24
11	26.67	319	2.78	36.1	9.63
12	18.38	302	2.78	28.8	5.29

thirds of the soluble solids of normal mature cornstalks consist of sugars.

The method was used here to measure the extract content of stalks of different varieties of hybrid corn that had borne mature ears.¹ Single stalks of 12 strains of hybrid corn were analyzed. The data, although not representing statistical averages, as would have been desirable, illustrate the application of the method and show in general the magnitude of the soluble solids differences found among stalks of different genetic origin.

Each stalk was finely ground by passing it through a motorized saw-blade grinder (2). The ground material was weighed, spread on a cloth-covered tray, and dried to constant weight at slightly below 50° C in an electrically heated dryer. It has been shown by Sayre and Morris (4) that drying cornstalk tissue at about 48° C gives correct dry weight percentages.

Thirty-gram samples of dry cornstalk were mixed in tared glass jars with approximately 300 ml of hot water, let stand to cool and to allow time for equilibrium to become established, then weighed, pressed in a tincture press, and the sp g of the juice measured by Brix spindle. To calculate percentage of extract, the weight of water present was divided by 100, minus the corrected Brix reading, and multiplied by 100. This gave weight of juice. This value, times the corrected Brix reading and divided by 100, gave the weight of juice solids in the 30 g of sample taken in terms of the sugar scale. Example: the corrected Brix was 2.11 and the total water present was 297 g, making the weight of juice 303.4 g. The weight of juice solids was $303.4 \times 2.11 \div 100$, or 6.40 g, or 21.3% of the sample taken.

The data are shown in Table 1.

Unexpectedly wide differences appeared in the extract percentages of the samples of different inheritance—20.9–52.1% on the dry matter basis, and 3.70–17.10% in

² Samples were obtained through the courtesy of J. D. Sayre, of the Ohio Agricultural Experiment Station, and were received in Scarsdale, New York, on September 28 by express from Wooster, Ohio. The stalks had been freed from ears, husks, leaves, leaf sheathes, and tassels and carefully packed in moistureproof bags. They were received in excellent condition.

terms of percentage of stalks. The high result of 52.1% is not new, as the value found by chemists of the Ohio Agricultural Experiment Station (5) in the case of the Burr-Leaming variety at maturity was a total sugar content of 35.6% on the dry matter basis, equal to 53.4% of soluble solids on the assumption that the sugars present were equal to two-thirds of the extract.

The extent to which these differences were due to genetic factors is unknown. If inheritance is indeed a controlling factor, an inexpensive method is evidently available for producing high sugar cornstalks: consisting of producing stalks from seed adapted to the locality, and having the property of producing stalks rich in extract at the time when the grain has reached maturity.

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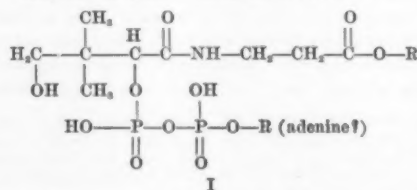
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Phosphates of Pantothenic Acid^{1, 2}

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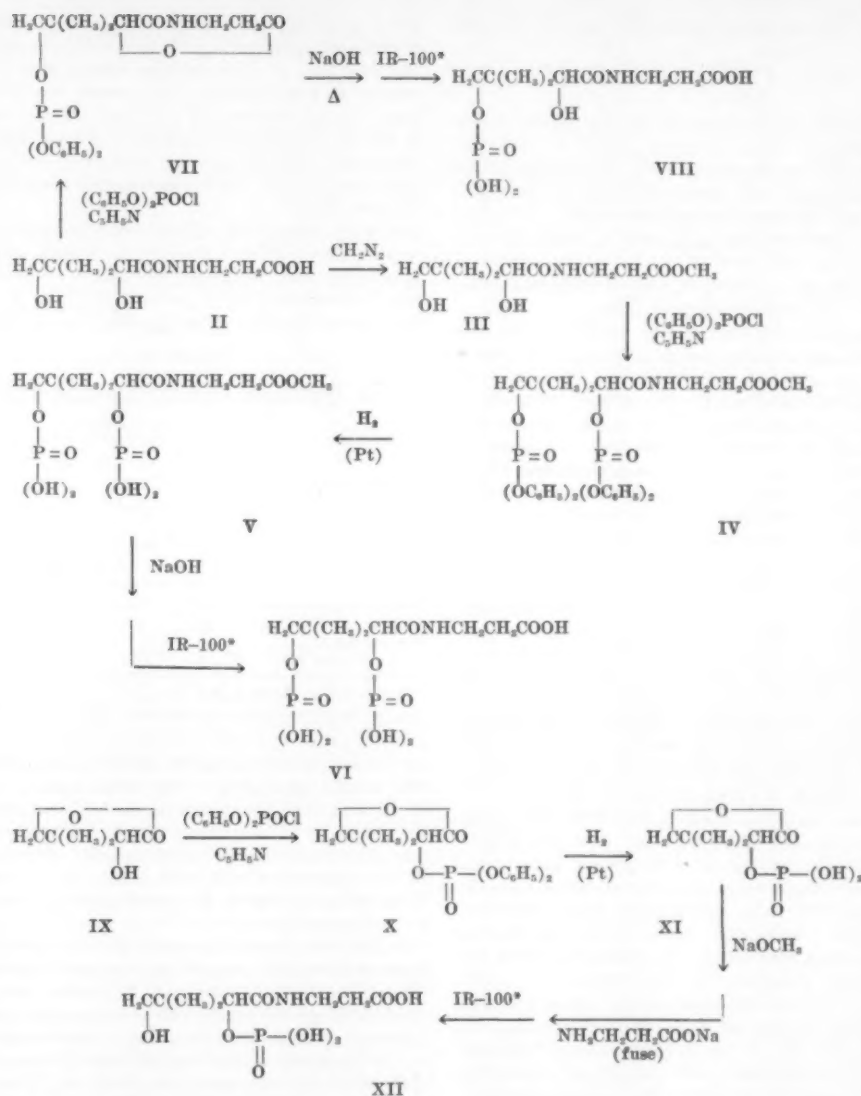
In view of the fact that phosphate derivatives of most B vitamins, rather than the free forms, take part in active biochemical processes and of the fact that both fractions of coenzyme A contain phosphorus (1), efforts have been under way for some time in this laboratory to prepare various phosphates of pantothenic acid and to test their biological activities. Recently Lipmann, Novelli, and co-workers have suggested that degradation products encountered during the isolation of coenzyme A may be resynthesized into the coenzyme and hence show acetylation activity *in vitro* in a crude pigeon liver enzyme system. On the basis of this and other work, especially degradation by various enzymes, they have proposed for the coenzyme the partial structure I (2):



¹Published with the approval of the Director, Wisconsin Agricultural Experiment Station.

²This investigation was supported in part by research grants from the National Institutes of Health, USPH.

^aThe authors wish to acknowledge the assistance of Winifred Rogers and Harvey Higgins in carrying out tests for pantothenic acid and coenzyme A activity.



* IR-100 = Amberlite IR-100, H-form.

FIG. 1. Synthesis of pantothenic acid phosphates.

It therefore seems desirable to report at this time a preliminary account of our work on pantothenic acid phosphates.

Woolley in 1940 reported the preparation of pantothenic acid diphosphate by direct phosphorylation of the vitamin with phosphorus oxychloride (5). Unfortunately several investigators have been unable to obtain the diphosphate by his method (4, 5, 6). Accordingly, other

phosphorylating agents were studied, and diphenylchlorophosphonate (7) was found satisfactory. The synthetic reactions carried out are summarized in Fig. 1. Methyl pantothenate (III), gave the bis-diphenylphosphate (IV) as expected, and removal of the phenyl groups from IV by reductive cleavage with hydrogen in the presence of Adam's catalyst gave methyl diphosphopantothenate, V, in good yield.

Anal. Calculated for $C_{10}H_{15}O_{11}NP_2 \cdot CH_3OH$: P, 14.59; N, 3.29.

Found: P (Fiske-SubbaRow), 14.2, N (Kjeldahl), 3.18.

Hydrolysis to the free acid, VI, was carried out in alkaline solution.

In contrast to the methyl ester, the reaction of free pantothenic acid with diphenylchlorophosphonate gave only a mono-diphenylphosphate derivative.

Anal. Calculated for $C_{20}H_{25}O_{11}NP$: C, 58.20; H, 5.57; N, 3.23; P, 7.15.

Found: C, 58.86; H, 6.95; N (Kjeldahl), 3.13; P (Fiske-SubbaRow), 6.8.

This result, and the fact that the product did not show any acidic characteristics, led us to formulate the product as the "gamma" phosphate, VII. This structure has not been otherwise established. The product, VII, was resistant to hydrogenolysis, but the phenyl groups were readily removed by alkaline hydrolysis to produce the free monophosphate, VIII. Although compounds VI and VIII have not been isolated in crystalline form as yet, the ratios of phosphorus content to pantothenic acid activity after enzymatic dephosphorylation closely approximate the theoretical values for the structures indicated.

The synthetic approach to the "alpha" monophosphate, XII, is outlined in Fig. 1. Pantoyl lactone was easily phosphorylated with diphenylchlorophosphonate as previously shown in this laboratory (16). Cleavage of the phenyl groups of the product was accomplished in this case more readily by hydrogenolysis than by alkaline hydrolysis. The free lactone phosphate, XI, was isolated as a crystalline product, mp 188° – 189° .

Anal. Calculated for $C_8H_{11}O_6P$: P, 14.8.

Found: P (Fiske-SubbaRow), 14.3.

The coupling of the disodium salt of XI with sodium β -alanate was made by direct fusion. After removing the sodium by ion exchange a crude product was obtained which was strongly acidic, free from inorganic phosphate (less than 0.1%), and showed typical bound pantothenic acid activity (see below). Since the starting materials did not possess such activity, it seems quite certain that the "alpha" phosphate, XII, was present.

All the reactions illustrated in Fig. 1 gave over 70% yield except the coupling of phosphopantoyl lactone with β -alanine, and the alkaline hydrolysis of the "gamma" mono-diphenylphosphate, VII. All three preparations (VI, VIII, and XII) were free from inorganic phosphate (less than 0.1%). Aqueous solutions of the free acids were highly acidic, and of the normal sodium or potassium salts, alkaline. The barium and calcium salts were soluble in water.

The pantothenic acid phosphates, like the natural bound forms of pantothenic acid (e.g., coenzyme A [8] and PAC [9]), were inactive to *Lactobacillus arabinosus*. However, the pantothenic acid could be liberated through treatment with intestinal phosphatase (1) and was thereby rendered available to lactic acid bacteria (Table 1). Other enzymes, like papain, pancreatin, and mylase-P, were ineffective for the liberation. Phosphopantoyllactone (XI) was slightly

active to *Acetobacter suboxydans*, but the phosphate derivatives of pantothenic acid were inert. Coenzyme A and PAC (10, 11) showed higher activity than the free vitamin in this organism. The present results demonstrate the high specificity of assimilation by the organism in that the free vitamin apparently combines with other components (possibly glutamic acid) and then is phosphorylated, whereas the prephosphorylated vitamins are not assimilable.

Both free pantothenic acid and methyl pantothenate are very sensitive to alkali. However, the vitamin activity of pantothenic acid phosphates was almost completely retained even after heating aqueous solutions in *N* sodium hydroxide in a boiling water bath for 1 hr (cf. Table 1).

TABLE 1
THE STABILITY OF PANTOTHENIC ACID PHOSPHATE

Compound tested	Treatment			
	None		N NaOH in boiling water bath for 1 hr	
	Free P.A.*	Total P.A.†	Free P.A.*	Total P.A.†
Percentage of P.A. activity				
Calcium pantothenate	100	100	0	0
Methyl pantothenate	20	26	0	0
Pantothenic acid diphosphate (IV)	2	100	2	80–100

* P.A. = pantothenic acid.

† As measured with *L. arabinosus* after double enzyme treatment (1).

At the same time no inorganic phosphate was liberated. The natural existence of alkali-stable forms of pantothenic acid has been previously reported from this laboratory (1, 18). Pantothenic acid diphosphate was also more stable than the free vitamin to acid. After heating in 1 *N* hydrochloric acid solution for 1 hr in a boiling water bath, 30–70% of the bound pantothenic acid activity was still intact.

In the crude pigeon liver system (13) pantothenic acid diphosphate in the presence of adenosine triphosphate showed unmistakable coenzyme A activity in several trials, although the results were erratic and not consistently reproducible. This occasional activity was probably due to a synthesis of the coenzyme from the pantothenic acid diphosphate and other components of the test system. Similar examples of enzymatic synthesis of other B-vitamin-containing coenzymes have been reported (14, 15). Further investigations along this line, and on the biological activity of the pantothenic acid phosphates *per se*, are in progress.

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The Abundance of Several Relatively Rare Elements in Igneous Rocks of North America¹

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Methods of precision spectrochemical analysis, which have recently been developed in the Department of Geology, MIT, are being applied to the quantitative analysis of 17 relatively rare elements in approximately 150 igneous rock specimens from North America. The whole project will involve 2,000-2,500 determinations, each in duplicate. Thus far, about 1,500 determinations have been made. There will, however, be considerable delay before the project is complete, and all the data assembled and discussed; this note is a preliminary report.

These elements are being determined: Li, Rb, Cu, Ag, Ga, Pb, La, Y, Nd, Sc, V, Co, Cr, Sr, Ba, Zr, and F. The present investigation is concentrated mainly on some common rock types, namely, diabase, granite, and basalt; later investigations may include other rock types, including sediments. One object of the investigation is the determination of the abundance of the above elements in igneous rocks of North America, first, for the sake of intercontinental comparisons and, second, to check existing abundance values for these elements in the earth's crust and to provide new and more precise values. Another object is a statistical survey of the abundance distribution of each element within a given rock type. Because precision methods are being used and because many specimens of each rock type have been analyzed, the analytical data may be handled statistically on a quantitative basis. For example, it is a well-known qualitative fact that gallium is relatively uniformly distributed in igneous rocks because of its close association with aluminum. Fig. 1 is a histogram

¹ This investigation is part of a general program of spectrographic research carried on in the Department of Geology, MIT, under contract with the Office of Naval Research, Washington, D. C., and under the supervision of H. W. Fairbairn.

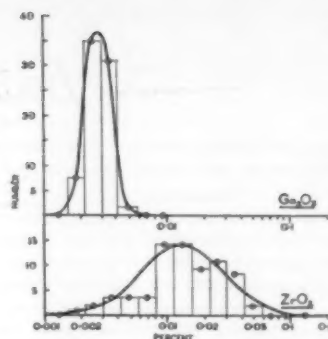


FIG. 1.

based on 75 specimens, which shows this quantitatively for diabase. For comparison, a histogram showing the distribution of zirconium in the same suite of specimens is also given in Fig. 1.

For many of the abundance measurements given during the past two decades, spectrochemical methods were employed. Although these served the desired purpose successfully, for the most part they were semiquantitative, and in many cases the analysis of each element involved a separate operation (re-arc-ing). In this investigation we have attempted to develop a limited number of general methods, each of which can handle several elements, and each of which may be regarded as a precision method. For example, in one method, Ga, Pb, Cu, and Ag are determined in a single operation; in another, V, Cr, Se, Y, La, Nd, Zr, Co, Ni, Sr, and Ba are determined. An indication of the reproducibility (precision) is given in Table 1, which shows some replicate analyses of gallium and of zirconium in a specimen of diabase.

TABLE 1

	% Ga ₂ O ₃		% ZrO ₂
	0.0027		0.014
	.0027		.014
	.0028		.013
	.0031		.014
	.0028		.012
	.0025		.014
	.0028		.014
	.0027		.013
	.0023		.013
	0.0025		0.012
Mean	0.0027	Mean	0.013

Although a given spectrochemical method may be precise, it may nevertheless introduce a systematic error (bias). The presence of such an error may cause considerable difficulty in correlating sets of analytical data from different laboratories. To reduce possible systematic error to a minimum, all determinations will be calibrated in terms of two naturally occurring standard specimens, one of granite and one of diabase. These specimens have been analyzed spectrochemically and colorimetrically for some elements in several laboratories.

Book Reviews

Electromagnetic Theory, Vols. I, II, and III. Reprint. Oliver Heaviside. New York: Dover, 1950. 386 pp. \$7.50.

Oliver Heaviside developed elementary vector analysis as we know it and published the first text on the subject (as a long chapter in *E. M. T.*), invented one form of operational analysis which has had wide influence, was the first to emphasize the use of semidivergent series in the solution of physical problems, developed the theory of the uniform two-conductor transmission line in *extenso*, made major contributions in the field of electromagnetic theory, predicted the existence of the ionosphere, introduced many now-commonplace terms such as "impedance," and raised such effective cry against the classical electric and magnetic units that the echo was still present when the MKS-ampere system came into vogue years later.

Dover's fine reprint of Heaviside's 3-volume *Electromagnetic Theory* on the hundredth anniversary of his birth offers an occasion to glance at this work from the vantage point of the present. The ardent but not uncritical disciple of Maxwell, who combined great creative ability with intense desire for simplicity and lucidity, gathered here many of his papers which were often written with an eye to continuity, the disjointedness of the usual volume of papers not being nearly so evident. What is evident is the up-to-dateness of Heaviside, a modern in whose work the past intrudes but quietly, and seldom commands. Dealing with fields in which great changes have taken place in the past 50 years, some major sections of *E. M. T.* could easily be used as textbooks for graduate courses today.

Heaviside received numerous honors during his lifetime, and saw many of his views accepted to such an extent that few today can conceive the shaking down over the years which was required to achieve this. His time of greatest productivity (1890-1905) was one in which Maxwell's theory was passing from possibility to probability, and in which the great industries "associated" with electromagnetic theory (power, communication) were rapidly broadening the bases on which the current giants were built. It is fascinating to follow technical growth as reflected in *E. M. T.* To take but one example, Heaviside was probably led to his development of the elementary vector analysis (which he was later accused of plagiarizing from Gibbs) to his operational calculus, and to his simplification of the basic equations by use of new units, by his desire to present and extend Maxwell's theory for the benefit of workers in the field. Yet later well-known books in electromagnetic theory (e.g., Jeans') practically disregarded vector analysis, the operational calculus had to be revived years afterward by Carson and Wagner, and units were not revised for many years. Numerous other examples from *E. M. T.* of technical growth via a Heaviside base, followed by

neglect, reaction, or rejection, followed by acceptance and expansion, might be cited.

A word about specific aspects of the present edition is called for. Ernst Weber has contributed an excellent introduction, and the format is unusually good. Printed on 9×12 pages, 4 pages of the original are reproduced photographically on one page of the new, with little reduction, so that 386 new pages cover 3 volumes of the original. Since most technical magazines—at least in engineering and physics—are now printed in approximately the same page size, why should technical books not be likewise? The ease of cross-referencing and of consulting figures with the large page would seem to more than compensate for the increased bulkiness.

And, quite incidentally, photographic reproduction leads to duplication of errors in the original (few, in the case of *E. M. T.*) and to its own errors—of a line that missed the camera, for example. The typographical errors in Professor Weber's typeset introduction are rather unfortunate.

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Cell Growth and Cell Function: A Cytochemical Study. Torbjørn O. Caspersen. New York: Norton, 1950. 185 pp. \$5.00.

This work is based on the author's Salmon Memorial Lectures given in 1948. The title is too big for this little book which is, at best, an outline guide to the extensive publications of Caspersen and co-workers on the subject of microspectrophotometry of biological materials and the function of nucleoprotein systems in cells. It deals primarily with the techniques and results in the ultraviolet spectrophotometry of cells. The subject is developed in six short chapters, with ninety-four illustrations. There is no index.

For the uninitiated the text is too brief. For example, Chapter II covers a wide range of complex physical problems in the ultraviolet microscopy of cellular components whose dimensions are near the theoretical limit of resolving power of any optical system. The reader is given a rapid outline of the principles and techniques developed in Dr. Caspersen's pioneering work. But the careful reader will find it necessary to refer to the original papers, to which there are ample references in this outline discussion. The critical biophysicist will wish there were more quantitative data given—for example, on the energy flux through the specimen—since quantitative figures usually enhance a concise presentation.

The jacket glibly says that this book presents "for the first time in book form the results of studies in cell processes made by quantitative cytochemical procedures." For those who eagerly read (and still have before them)

the *Acta Radiologica Supplement* of 1944 by Caspersson and Santesson on the protein metabolism of tumors, this statement must evoke a wry smile. However, this book does mention the tumor material of the 1944 book under the heading of "disturbed systems for protein metabolism," after having described the undisturbed systems in normal metazoan cells. It covers the subject of protein synthesis in a general sense by including a description of the process in bacteria and in viruses. Dr. Caspersson's diagrams showing protein reproduction, and virus reproduction, are thought-provoking and help enormously, along with the generous number of graphs and photographs, to supplement the sketchy text.

By virtue of its brevity this is a stimulating book in that it sets forth ideas in concise form about the mystery of the everyday creation of cells. Although incomplete, these ideas are important now; for there is a great need of new concepts about the fundamental mechanism of cell reproduction. The newcomer to the subject of microspectrometry of cells will find here a quick introduction and survey of the subject. The expert will hope that this book may become the starting point for a more detailed "treatise" on living matter.

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The Cerebral Cortex of Man: A Clinical Study of Localization of Function. Wilder Penfield and Theodore Rasmussen. New York: Macmillan, 1950. 248 pp. \$6.50.

Penfield and his associates have given us a series of important papers and monographs concerning cerebral function, and this study is another important contribution. It covers some old ground by presenting evidence concerning epileptic attacks and cortical ablation in different areas of the cortex and in describing some effects of electrical stimulation of the cortex in conscious human patients. It is the first time, however, that we have a relatively complete account of stimulation-work for a wide variety of cortical areas. It is this fact, and the conclusions that come out of it, that make this monograph truly valuable.

The Cerebral Cortex of Man describes the many observations that have been made during brain surgery of the perceptions, memories, and thoughts evoked in patients by electrical stimulation of different cortical points. The method confirms and elaborates what we already know about the position and organization of the primary somatic and motor areas. When these areas are stimulated, patients give simple movements or report primitive sensations. The monograph further tells, however, of the existence of a second motor area at the foot of the central sulcus along the rostral border of the lateral fissure. And it reveals that there is a supplementary motor area in the dorsal and medial part of the frontal lobe just in front of the classical motor points for the feet and toes.

The monograph also throws some light on the mechanisms of aphasia. It describes the prompt arrest of

speech when either the supplementary motor area or the sensorimotor regions representing speech are stimulated. More important is the fact that an aphasic arrest may be produced by stimulating three different areas: a frontal area approximately the same as Broca's classical area, a parietal area at the posterior end of the lateral fissure, and a temporal area in the occipitotemporal region.

Extremely interesting to neurologists and psychologists alike are observations that complex perceptions and memories can be elicited by stimulating some of the "association" areas of the cortex. Stimulating the secondary sensory areas evokes complex sensations or perceptions, and stimulating the temporal lobe produces relatively complex sequences of memory.

Penfield and Rasmussen put forth some interesting interpretations of their data. Among them is the idea that memory patterns are localized primarily in the temporal lobe and that the elaboration of thought is a function of the frontal lobe. They also argue that the center for the integration of consciousness and complex processes is not in the cerebral cortex but in the diencephalon, and they have good evidence to bolster this notion.

This is not the place to give further details of this monograph. Suffice it to say that this is an extremely important contribution, because it presents new and convincing evidence about cortical function and new hypotheses about the physiological mechanisms of perception, memory, thought, and consciousness.

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Scientific Book Register

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German-English Technical and Engineering Dictionary. Louis de Vries. New York: McGraw-Hill, 1950. 928 pp. \$20.00.

Association Affairs

The Cleveland Meeting, December 26-30, 1950

III—The Programs in Biology and Medicine

THE following outline of programs in the fields of biology and medicine constitutes a third portion of the advance information on the 117th Meeting of the Association. Part I—*The Annual Science Exposition*, and Part II—*The Programs in Mathematics, Physics, Astronomy, and Chemistry* (in part) appeared in *SCIENCE* for October 27 and November 3.

PROGRAM OF SECTION C—CHEMISTRY

(Note: Sessions 1 and 2 and 3 and 4 of Section C—two two-session symposia on *Advances in Inorganic Chemistry* and *Forensic Science*—were reported last week.)

Session 5. Wednesday afternoon, December 27, Edward F. Degering, Miner Laboratories, Chicago, presiding.

1. "Seven Echoes from History." Edward F. Degering.

2. "Free Radical Aromatic Substitution." R. L. Dannley and Morris Gippin, Western Reserve University.

3. "The Structure of Heparins." M. L. Wolfrom, Ohio State University; Rex Montgomery, Eastern Regional Laboratory, Philadelphia; and J. V. Karabinos and P. Rathgeb, Rockefeller Institute for Medical Research.

4. "The Chemist Helps the Dentist." Frances Krasnow, Guggenheim Dental Clinic.

5. "National Cooperative Undergraduate Chemical Research Program." Mrs. Warren P. Cortelyou, Evanston, Illinois.

6. "Some Reactions of Ketene and Diketene." Edward F. Degering; L. L. Bolstad, Sheltering Army Hospital, Minneapolis; L. B. DeHoff, North Dakota State College; A. W. Fuhrman, Naugatuck Chemical Company; B. H. Gwynn, Gulf Research and Development Co.; J. F. Hall, Purdue University; J. M. Snyder, E. I. Du Pont de Nemours & Co.; J. A. Spence, California Research Corporation; and L. G. R. Tompkins.

7. "Quantitative Studies on Urinary Thiosulfate Excretion by Human Beings." Joseph H. Gast and Kasko Arai, Baylor University College of Medicine.

Sessions 6-7. *Symposium on Steroid Hormones*, Hal G. Johnson, Monsanto Chemical Company, presiding.

Part I. Thursday morning, December 28.

1. Introductory Remarks. Hal G. Johnson.

2. "Steroid Hormones and Aging." John E. Kirk, Washington University School of Medicine.

3. "Summary of the Chemistry and Progress Made with Cortisone." Max Tishler, Merck & Co., Inc.

4. "Physiologic Activity of Cortisone and Related Compounds." H. F. Polley, Mayo Clinic.

5. "Chemistry of the Steroidal Sapogenins." R. B. Wagner, Pennsylvania State College.

Part II. Thursday afternoon, December 28.

6. "Metabolism of Adrenocortical Hormones." K. Dobringer, Sloan-Kettering Institute for Cancer Research.

7. "Clinical Uses of ACTH." John R. Mote, Armour Laboratories.

8. "A New Route to 11' Ketosteroids via 9, 11-oxygenated Compounds." Hans Heymann, University of Oregon.

9. "Biological Introduction of Oxygen at Position 11 of the Steroid Molecule." Robert P. Jacobsen, Worcester Foundation.

Session 8. *Symposium on Antibiotics and Vitamins*, Friday evening, December 29, Herbert E. Carter, University of Illinois, presiding.

1. Introductory Remarks. "Recent Advances in the Chemistry of the Antibiotics and Vitamins." Herbert E. Carter, University of Illinois, and Stanton A. Harris, Merck & Co., Inc.

2. "Hydroxystreptomycin." J. R. Schenck, Abbott Laboratories.

3. "Stereochemistry of Streptomycin." M. L. Wolfrom.

4. "Neomycin." Robert L. Peck, Merck & Co., Inc.

5. "Chemical Assay of Vitamin B₁₂ (Cyano-Cobalamin)." George E. Boxer, Merck & Co., Inc.

Sessions 9-10. *Symposium on Agricultural Chemicals*, Hal G. Johnson, Monsanto Chemical Company, presiding. **Part I.** Saturday morning, December 30.

1. Introductory Remarks. Hal G. Johnson.

2. "The Outstanding Agricultural Chemical Developments of the Past Ten Years." L. A. Long, Agricultural Chemicals, New York.

3. "Field Testing of Fungicides." J. D. Wilson, Ohio Agricultural Experiment Station.

4. "Insecticide and Fungicide Research and Development." W. H. Tisdale, E. I. Du Pont de Nemours & Co.

5. "The Place of Herbicides in Modern Agriculture." L. V. Sherwood, Monsanto Chemical Company.

Part II. Saturday afternoon, December 30.

6. "Relationship of Halogen Position to Physiological Action in the Mono- and Polychlorophenoxyacetic Acids." J. M. F. Leaper, American Chemical Paint Company.

7. "Chemicals for the Control of Fruit Diseases." John G. Dunegan, Bureau of Plant Industry, USDA.

8. "Development of Parathion and its Place in Agriculture." J. L. Horsfall, American Cyanamid Company.

9. "Specificity of Fungicidal Action." George L. McNew, Boyce Thompson Institute.

PROGRAM OF SECTION F—ZOOLOGICAL SCIENCES

Session 1. Wednesday afternoon, December 28, business meeting.

Session 2. Thursday afternoon, December 28, joint sym-

posium of Section F and Section B—Physics on *The Implications of Nuclear Phenomena in Biology*. D. D. Van Slyke, Brookhaven National Laboratory, presiding.

1. Introductory Remarks. D. D. Van Slyke.

2. "Role of Tracer Elements in Biological Investigations." Harland G. Wood, Western Reserve University.

3. "Effects of High Energy Radiation and their Usefulness in Biology and Medicine." G. Failla, Columbia College of Physicians and Surgeons.

Session 3. Friday afternoon, December 29, joint symposium of Section F, Section I—Psychology, and the American Society of Zoologists on *Genetics and Behavior*, Calvin S. Hall, Western Reserve University, presiding.

1. "Factors in Maternal Behavior and Early Socialization." T. C. Schneirla, American Museum of Natural History. Discussant: Nicholas E. Collias, University of Wisconsin.

2. "Genetics, Temperament, and Social Behavior." J. P. Scott, Roscoe B. Jackson Memorial Laboratory. Discussant: O. H. Mowrer, University of Illinois.

3. "Gene Mechanisms and Behavior Patterns." John L. Fuller, Roscoe B. Jackson Memorial Laboratory. Discussant: Ward C. Halstead, Department of Medicine, University of Chicago.

Section F also is cosponsoring the first two parts of the four-session symposium on *Radiobiology*, which follows under Subsection Nm—Medicine.

AMERICAN SOCIETY OF PARASITOLOGISTS

The program of the 25th annual meeting of the American Society of Parasitologists begins Wednesday morning, December 27, and concludes Friday afternoon, December 29. Headquarters will be at the Hotel Hollenden. In addition to four sessions for contributed papers, the sessions of Thursday comprise:

Morning. Symposium on *Host-Parasite Relationships among the Helminths*, H. W. Manter, University of Nebraska, presiding.

1. "Host-Parasite Relationships among the Digenetic Trematoda." George R. LaRue, University of Michigan.

2. "Host-Parasite Relationships in Cestode Infections, with Emphasis on Host-Resistance." J. E. Larsh, Jr., University of North Carolina.

3. "Evolution of Zooparasitic Groups in the Phylum Nematoda." E. C. Dougherty, University of California at Berkeley.

Commemoration of the 25th anniversary of the society: W. W. Cort, The Johns Hopkins University, and E. B. Cram, National Institutes of Health.

Presidential address. "Medical Parasitology in a Changing World: What of the Future?" W. H. Wright, Laboratory of Tropical Diseases, National Institutes of Health.

Afternoon. Annual luncheon and business meeting, Ballroom of Hotel Hollenden.

Demonstration session, joint with American Society of Zoologists, Laboratories, Biology Building, Western Reserve University, Professor A. H. Hersh, Department of Biology, presiding.

AMERICAN SOCIETY OF PROTOZOOLOGISTS

The program of the American Society of Protozoologists,

organized at the Chicago Meeting of the AAAS in 1947, has grown to the point that, this year, there will be four paper-reading sessions on Wednesday and Thursday, December 27 and 28, and on Friday, December 29, a luncheon and business meeting, R. P. Hall, Department of Biology, New York University, presiding. All sessions will be in the Hotel Hollenden.

AMERICAN SOCIETY OF ZOOLOGISTS

The sessions of the American Society of Zoologists, with headquarters at the Hotel Hollenden, begin Wednesday afternoon, December 27, and end Saturday noon, December 30. They are as follows:

Wednesday afternoon. Symposium on *Transition from Aquatic to Land Life*, Alfred S. Romer, Harvard University, presiding.

1. "Routes That Animals Took in Emigrating from Sea to Land." A. S. Pearce, Duke University.

2. "The Reproductive and Development Problem Associated with Land Colonization." J. A. Moore, Columbia University.

3. "The Role of the Kidney in the Evolution of Land Animals from Water-dwelling Ancestors." Roy P. Forster, Dartmouth College.

Thursday morning. Four concurrent sessions in general physiology, embryology, endocrinology, and cytology and protozoology.

Thursday afternoon. Three concurrent sessions—on the campus of Western Reserve University—in cellular physiology, demonstrations, jointly with the American Society of Parasitologists, and demonstrations by motion pictures, Ralph Buchsbaum, University of Chicago, presiding.

Friday morning. Three concurrent sessions in animal behavior and sociobiology, endocrinology, and *Part I* of the Symposium on *Radiobiology*, jointly sponsored by Subsection Nm—Medicine, Section F—Zoological Sciences, and the American Society of Zoologists.

Friday afternoon. The two concurrent sessions are *Part II* of the symposium on *Radiobiology* and the symposium on *Genetics and Behavior* already described.

Friday evening. Zoologists' Dinner in the Hotel Hollenden. L. V. Domm, University of Chicago, vice president and chairman of Section F, will deliver, as his presidential address, "Sex Differentiation: Genes or Hormones."

Biologists' Smoker. The Biologists' Smoker, cosponsored by the American Society of Zoologists and the AAAS, will be in the South Exhibition Hall of the Cleveland Public Auditorium.

Saturday morning. Three concurrent sessions in general physiology, embryology, and general morphology.

SOCIETY OF SYSTEMATIC ZOOLOGY

The Society of Systematic Zoology, organized at the Annual Meeting of the AAAS in Chicago in 1947, has enjoyed a remarkable growth. The current membership is almost 800. The program of the third annual meeting of the society includes a symposium Wednesday evening, December 27, a breakfast meeting, and afternoon business meeting, Friday, December 29.

Wednesday evening. Symposium on *The Role of Sys-*

tematics in Modern Zoology, D'Alte A. Welch, John Carroll University, presiding.

1. "The Place of Systematics in Zoology as Illustrated by Studies of the Arachnida." Alexander Petrunkevitch, Yale University.

2. "North American Natural History Museums and their Relation to Systematic Zoology." Waldo L. Schmitt, U. S. National Museum.

3. "The Application of Quantitative and Experimental Methods to Problems in Systematic Zoology." Lee R. Dice, University of Michigan.

HERPETOLOGISTS LEAGUE

Wednesday Morning, December 27, conference of Mid-western Herpetologists.

AMERICAN MICROSCOPICAL SOCIETY

Session 1. Friday morning, December 29, Hotel Hollenden, symposium on *Modern Methods for Microscopy*, Oscar W. Richards, American Optical Company Research Laboratories, Stamford, Connecticut, presiding.

1. "Introduction and Various Methods of Microscopy—Interference, Phase, Television, and X-Ray." Oscar W. Richards.

2. "The Refractive Index of Protoplasm as Determined by Microscopical Methods." Germain C. Crossman, Bausch & Lomb Optical Co. Research Laboratories.

3. "Fluorescence Microscopy." Charles Maresh, Calco Chemical Division, American Cyanamid Company.

4. "The Reflecting Microscope in Infrared Spectrometry." D. L. Wood, University of Michigan.

5. "Recent Advances in Biological Polarization Microscopy." H. S. Bennett, University of Washington.

6. "Polaroid Ultraviolet Color Translation Microscopy." E. H. Land, Polaroid Corporation.

Session 2. Friday afternoon, December 29, annual business meeting.

BIOMETRIC SOCIETY, EASTERN NORTH AMERICAN REGION

The program of the Biometric Society, Eastern North American Region, consists of a six-session symposium on *Mathematical Biology and Biometry*, mornings and afternoons of Wednesday, Thursday, and Friday, December 27–29. The details of this program, cosponsored by Section A, appeared in *SCIENCE* last week.

NATIONAL SPELEOLOGICAL SOCIETY

Four papers in the two sessions of the National Speleological Society, Thursday, December 28, deal with such cave fauna as snails, salamanders, and bats.

PROGRAM OF SECTION G—BOTANICAL SCIENCES

Session 1. Wednesday afternoon, December 27, contributed papers, John S. Darling, Purdue University, presiding.

1. "The Biology and Histology of the *Solidago* Leaf Gall Inhabited by *Asphondylia monacha*." Edwin G. Beck, University of Georgia.

2. "The Nature of the Gall Stimulus in the Elliptical *Solidago* Gall Caused by the Larva of *Gnorimoschema gallaesolidaginia*." Edwin G. Beck.

3. "Relation of Structure to Physiological Activity of Plant Growth-regulatory Compounds." R. L. Weintraub and J. W. Brown, Biological Department, Chemical Corps, Camp Detrick.

4. "Movement of Radioactive Calcium in White Pine and Yellow Birch." C. A. Mawson, Atomic Energy Project, National Research Council, Chalk River, Ontario, and Donald A. Fraser, Forest Insect Laboratory, Department of Agriculture, Saulte Ste. Marie, Ontario.

5. "Morphogenetic Variations of the Embryo of *Polypodium aureum* L." Max Ward, Glenville State College.

6. "Spore Characters and Spore Germination." Beverly Heller, Mistaire Laboratories.

7. "Techniques of Germination of Difficult Spores and Seeds." Clara S. Hires, Mistaire Laboratories.

8. "Diagnostic Characters of the Perispore: An Aid in the Taxonomy of *Dryopteris*." Fern W. Crane, Mistaire Laboratories.

9. "Some Preliminary Results in the Preparation of a 'Pollen Atlas.'" S. A. Cain, University of Michigan.

10. "Recent Advances in Danish Pollen Analysis." Svend T. Anderson, Danish National Museum, Copenhagen.

Session 2. Wednesday evening December 27, vice-presidential address and business meeting, Stanley A. Cain, presiding.

1. "Remarks on the Future of Section G and Botanical Meetings." John S. Karling, Purdue University, chairman, Section G.

2. Discussion.

Session 3. Thursday morning, December 28, contributed papers, Stanley A. Cain, presiding.

1. "How Vegetation is Invading Areas Made Bare by the Mexican Volcanoes Jorullo and Parícutin." W. A. Egger, Tulane University.

2. "*Scirpus Americanus* and other Plants of Recently Formed Lands at the Mouths of Distributaries of the Mississippi River." W. A. Egger.

3. "A Floristic-Ecologic Analysis of the Grass Flora of Arizona." Robert A. Darrow, Agricultural and Mechanical College of Texas.

4. "Endemic Plants and Geological History of Texas." Lloyd H. Shinnars, Southern Methodist University.

5. "Role of the American South in Systematic Botany." Lloyd H. Shinnars.

6. "Effects of Controlled Burning in the New Jersey Pine Barrens." Murray F. Buell, Rutgers University, and John E. Cantlon, George Washington University.

7. "Dating and Multiplicity of Growth Layers in Branches of Trees from the Lower Forest Border." Waldo S. Glock, Macalester College, and R. A. Studhalter, Texas Technological College.

8. "Cambial Activity in Certain Forest Trees at Chalk River, Ontario." Donald A. Fraser.

9. "Some Botanical Results of the Baird Expedition (1950) to the River Clyde Area, Baffin Land." Pierre Dansereau, University of Michigan.

Session 4. Friday morning, December 29, Symposium on *The Ecological Background of Evolution*, jointly

sponsored by the Ecological Society of America, Stanley A. Cain, presiding.

1. "Ecological Barriers." Herbert P. Riley, University of Kentucky.

2. "Aridity as a Stimulus to Plant Evolution." G. Ledyard Stebbins, Jr., University of California at Davis.

3. "Evolutionary Opportunity." Pierre Dansereau.

4. "Perspectives in the Study of Adaptation and Selection." Colin Pittendrigh, Princeton University.

5. "The Evolution of Floras versus the Evolution of Species." Edgar T. Anderson, Washington University.

Sessions 5-6. Two-session symposium on *The Structure and Analysis of Plant Communities*, jointly sponsored by the Ecological Society of America, John S. Karling, presiding.

Part I. Saturday morning, December 30.

Part A. General introduction.

1. "Some Problems raised by Standard Phytosociological Methods." Stanley A. Cain.

Part B. Secondary Grassland Studies—George Reserve, State of Michigan.

2. "The Effects of Quadrat Technique on Sample Data." Francis C. Evans, Laboratory of Vertebrate Biology, University of Michigan.

3. "Measures of Clumping Based on Contagious Distributions." George Thomson, Ethyl Corporation.

4. "The Measure of Spacing." Lee R. Dice.

Part II. Saturday afternoon, December 30.

Part C. Forest Problems.

5. "Original Forest Structure." John T. Curtis, University of Wisconsin.

6. "Quadrat and Random Pair Studies of Forest Structure." Grant Cottam, University of Wisconsin.

7. "The Practicing Forester Views the Situation." Kenneth P. Davis, Department of Forestry, University of Michigan.

PROGRAM OF SUBSECTION NM—MEDICINE

Sessions 1-4. A four-session symposium on *Radiobiology*.

Part I. Friday morning, December 29, a joint session of Subsection Nm, Section F—Zoological Sciences, and the American Society of Zoologists, Joseph H. Bodine, State University of Iowa, presiding.

1. "The Effects of Low Intensities of Radiation on Plant Development." Karl Sax, Arnold Arboretum.

2. "Plant Growth and Growth Hormone Relationships as Affected by Ionizing Radiation." Solon A. Gordon, Argonne National Laboratory.

3. "Radiation-Induced Mutations in Chemical Requirements of *Salmonella*." H. H. Plough, Amherst College.

4. "Modification of the Frequency of Radiation-induced Chromosome Changes and Mutations and their Significance." Carl P. Swanson, The Johns Hopkins University.

5. "The Genetic Effects of Radiation in Mammals." W. L. Russell, Oak Ridge National Laboratory.

Part II. Friday afternoon, December 29, a joint session of Subsection Nm, Section F, and the American Society of Zoologists, H. H. Plough, Amherst College, presiding.

1. "The Effects of Radiation on Some Chemical Com-

pounds." A. K. Solomon, Harvard Medical School.

2. "The Radiation Chemistry of Cysteine Solutions." S. L. Witcher and Mary Rotheram, University of California.

3. "Some Experiments on the Fundamental Action of X-Rays on Cells." Titus C. Evans, State University of Iowa College of Medicine.

4. "Secondary Factors Influencing the Sensitivity of Living Cells to Radiation." Alexander Hollaender, Oak Ridge National Laboratory.

5. "The Effects of Local X-Ray Irradiation upon the Development of Jaws in the Young Axolotl, *Siredon mexicanum*." V. V. Brunst, E. A. Sheremetieva-Brunst, and F. H. J. Figge, Department of Anatomy, University of Maryland.

6. "Effects of Radioactive Iodine on the Rat Thyroid." Simon Koletsky, Department of Radiology, Western Reserve University.

Part III. Saturday morning, December 30, Hymer L. Friedell, Western Reserve University, presiding.

1. "Some Effects of X-Rays on Mammalian Testicles." Lloyd C. Fogg, Pondville State Hospital, Norfolk, Massachusetts.

2. "Some Effects of Ionizing Radiation on Developing Mammalian Brain." Samuel P. Hicks, New England Deaconess Hospital.

3. "The Effects of Radiation on Water Metabolism of Rats." Abraham Edelmann, Brookhaven National Laboratory.

4. "The Effects of Ionizing Radiation on Gastrointestinal Function." Douglas E. Smith, Argonne National Laboratory.

5. "Observations of Renal Function in Patients Receiving Internally Administered Radioactive Isotopes." Lee E. Farr, Brookhaven National Laboratory.

6. "The Influence of Certain Physical and Biological Factors on the Lethal Effect of X-Radiation in Mice." Henry S. Kaplan, Stanford University.

Part IV. Saturday afternoon, December 30, G. Failla, Columbia University College of Physicians and Surgeons, presiding.

1. Vice president's address. Joseph C. Hinsey, Cornell University Medical College, and chairman, Section N—Medical Sciences.

2. "The Potential Radiotoxicity of Carbon 14." Donald L. Buchanan, Argonne National Laboratory.

3. "The Synergism Resulting from Various Radioisotopes Administered in Combination." Hymer L. Friedell, Western Reserve University.

4. "Metabolic Factors in Radiosensitivity." Harvey M. Patt, Argonne National Laboratory.

5. "Studies on the Nature of the Protective Mechanism of Glutathione against Radiation Injury." E. P. Cronkite, National Naval Medical Center, George Brecher, National Institutes of Health, and W. H. Chapman, Naval Medical Research Institute.

6. "The Treatment of Irradiation Sickness." J. Garrett Allen, University of Chicago.

PROGRAM OF SUBSECTION ND—DENTISTRY

Three sessions of papers on dental research in govern-

mental agencies are scheduled for Friday evening, December 29, Saturday morning and Saturday afternoon, December 30.

PROGRAM OF SUBSECTION NP—PHARMACY

All four sessions of Subsection Np are jointly sponsored by the American Pharmaceutical Association, Scientific Section.

Session 1. Thursday morning, December 28, contributed papers, Glenn L. Jenkins, Purdue University School of Pharmacy, presiding.

1. "Vitamin Stability Studies in Pharmaceutical Products." R. F. Prindle, Strong, Cobb & Company, Inc.

2. "The Determination and Stability of Ferrous Gluconate." Ladimer Mareah and R. F. Prindle, Strong, Cobb & Company, Inc.

3. "Diuretic Properties of Some Alkyl-Sugar Derivatives." Floyd Skelton and Gordon A. Grant, Ayerst, McKenna & Harrison.

4. "The Effect of α -Butanol in Sodium Salt Solutions upon Shock and the Survival of Mice Exposed to Severe Extensive Thermal Burns." R. A. Ravich and Emanuel Revi, Institute of Applied Biology.

5. "The Determination of the Penetration of Certain Sodium Alkyl Sulfates and Sodium Sulfate through Rat and Mouse Skin." P. M. Scott, State College of Washington, L. D. Edwards, Purdue University School of Pharmacy, and J. E. Christian, Washington State College School of Pharmacy.

6. "The Isotope Dilution Procedure of Analysis." J. E. Christian, J. J. Pinnjian, and W. E. Wright, Purdue University School of Pharmacy.

Session 2. Thursday afternoon, December 28, contributed papers, Albert M. Mattocks, secretary, American Pharmaceutical Association, presiding.

1. "A Study of Folic Acid Stability in Solutions of the B-Complex Vitamins." A. R. Biamonte and G. H. Schneller, Calco Chemical Division, American Cyanamid Company.

2. Khellin—Part I. "Ultraviolet, Infrared, and Polarographic Studies on Three Principles Isolated from Ammi Vianaga." S. D. Bailey and P. A. Geary, Research Division, Smith, Kline & French Laboratories; and A. E. DeWald, University of Minnesota.

3. Khellin—Part II. "Methods for the Determination of Three Principles Isolated from Ammi Visnaga Lam." W. C. Ellenbogen, E. S. Rump, P. A. Geary, and M. Burke, Research Division, Smith, Kline & French Laboratories.

4. "Analytical Problems in Pharmaceutical Products." M. G. Girbino, Strong, Cobb & Company, Inc.

5. "Antifungal Properties of Some Antihistamines." G. C. Walker, Ontario College of Pharmacy, H. George DeKay, Purdue University School of Pharmacy, and C. L. Porter, Purdue University.

Sessions 3-4. Seminar on *Hospital Pharmacy*.

Part I. Friday morning, December 29, Don E. Francke, University Hospital, Ann Arbor, Michigan, presiding.

Part II. Friday afternoon, December 29, Mrs. Evelyn Gray Scott, St. Luke's Hospital, Cleveland, presiding.

ALPHA EPSILON DELTA—NATIONAL PREMEDICAL HONOR SOCIETY

Annual luncheon and session, Thursday, December 28, Hugh E. Setterfield, School of Medicine, Ohio State University, national president, presiding.

1. "Medical Education in the World Crisis," S. Kimball, School of Medicine, University of Buffalo.

2. "Summary of the First National Conference on Premedical Education." H. E. Setterfield.

3. Informal round-table discussion. Dean Kimball will include a discussion of the present plans for assuring a continuous supply of qualified premedical and medical students as part of the preparedness program for the medical profession in the present world crisis.

AMERICAN DIETETIC ASSOCIATION

Session on Friday evening, December 29, Helen A. Hunscher, Western Reserve University, presiding.

1. "Endemic Goiter a Food Deficiency Disease." Oliver P. Kimball, Cleveland, Ohio.

2. "Rehabilitation of Children through Better Nutrition." Pauline Beery Mack, Ellen H. Richards Institute, Pennsylvania State College.

AMERICAN NATURE STUDY SOCIETY

The four days of sessions of the American Nature Study Society will be outlined later with the programs of the science-teaching societies. Biologists in general, however, will be interested in the following:

The Annual Banquet of the ANSS, Friday evening, December 29, at which Warner Seely, Cleveland Bird Club, will be toastmaster. An illustrated lecture by Arthur A. Allen, Department of Ornithology, Cornell University, will follow.

The all-day Field Trip, Saturday, December 30, jointly sponsored by the American Nature Study and the National Association of Biology Teachers. The leaders include Joseph Maddox, Ellis Persing, Harold Wallin, and Roger Tory Peterson.

SIGMA DELTA EPSILON

(Graduate Women's Scientific Fraternity)

Sigma Delta Epsilon will have four sessions during the period December 26-30. It will maintain its usual convention headquarters room at which all graduate women in science are welcome. On Wednesday, December 27, President Barbara K. Campbell, Indiana University, will preside, and the luncheon speaker will be Mary L. Sherrill, Mount Holyoke College. Winners of the Sigma Delta Epsilon Research Awards will be announced.

THE SOCIETY OF THE SIGMA XI

The Annual Address of the Society of the Sigma Xi, on Wednesday evening, December 27, will interest all biologists. "The Macromolecular Texture of Biological Materials" is the subject of an illustrated lecture by Ralph W. G. Wyckoff, scientist director of the Laboratory of Physical Biology, Experimental Biology and Medicine Institute, National Institutes of Health. Among the electron micrographs shown and discussed will be muscle, connective tissue, and nervous tissue cells, dividing cells, and plant and animal virus-infected cells.

RAYMOND L. TAYLOR

Assistant Administrative Secretary

News and Notes

Pennsylvanian-Permian Field Conference

Aureal T. Cross

West Virginia Geological and Economic Survey, Morgantown

A special field conference on the stratigraphy, sedimentation, and nomenclature of the Upper Pennsylvanian and Lower Permian strata was held in southeastern Ohio, northern West Virginia, and southwestern Pennsylvania, September 8-10. About 40 geologists led by Aureal T. Cross, of the West Virginia and Ohio Geological Surveys, attended. The Geological Surveys of Ohio and West Virginia joined in the sponsorship, with the cooperation of the Coal Committee of the Society of Economic Geologists.

The route of the trip included the type areas of the Monongahela, Washington, and Greene series, and a large number of the type localities for the named stratigraphic units. Many sedimentary anomalies, lateral continuity of various lithologic units, cyclic groupings of these strata, and lateral variations of the facies were repeatedly pointed out and discussed. Numerous comments by some of the leading geologists in this field of study were recorded.

A comprehensive field guide, or "work book," for the use of the participants was prepared by Dr. Cross, with the assistance of Thomas Arkle, Jr., and Wm. H. Smith, of the West Virginia and Ohio Geological Surveys, respectively. It includes a lengthy road log, 63 columnar profiles and geologic diagrams, 3 maps, a statement of problems and ideas to be discussed and explored, several pages of remarks, and a pocket containing 6 prepared charts of geologic columns, correlations sheets, etc. Copies of this guide are still available at \$2.50 each.

Following repeated demonstrations in the field of the problems associated with the geology of the area, the participants were called upon for comments and opinions at evening sessions led by Dr. Cross in Wheeling and Morgantown. A record of these comments now being circulated among the participants, may later be summarized and published, along with contributions at additional conferences already planned.

As a result of proposals made and opinions expressed at the conference a complete revision of the stratigraphic nomenclature of these series appears to be desirable. Continuity of the sedimentary members and their grouping into cyclothems are now generally agreed upon. The

lack of any major change of lithology or break in the sedimentary record from Upper Conemaugh to the top of the Greene series, and the relatively minor amount of westward thickening of the sediments in this area seem to be established and accepted ideas. The change in facies in the northern portion of the Dunkard Basin from the shoreward (east or southeast) side of the sedimentation to the seaward side (northwest to west in Ohio) was shown for all three series to be essentially similar, with eastward transgression of the sea being probable. The principal components of the facies of each series from east to west are hard, gray, fresh-water(?) limestones with a few gray shales and coals, and some sandstone, grading westward into thinner gray limestones and thicker intercalated gray shales and impure sandstones, with coals generally impure and thin. The latter give way to the west to incursions of red shales of highly calcareous nature, with or without intercalated limestone beds which, when present, are very impure and often variously colored, with very shaly sandstones. The coal horizons are commonly represented by no more than carbonaceous smuts or leached zones at the top of the underclay.

The sandstones are the most unpredictable of all the sedimentary units, and the coals and/or underclays are the most constant features of the cyclothems. The use of a single name for all the lithologic units of a single cyclothem was suggested by Dr. Cross as a reasonable solution for the present confused and incomplete state of the nomenclature of these and comparable cyclic accumulations in other areas.

In this respect a round-table conference, sponsored by the Coal Committee of the Society of Economic Geologists, to discuss these problems and their relationship to similar problems of comparable strata elsewhere will be held at 2:00 P.M., November 17, in the South American Room of the Statler Hotel, Washington, D. C., in conjunction with the Geological Society of America meetings. Paul H. Price, State Geologist of West Virginia, and John Melvin, State Geologist of Ohio, will serve as co-chairman, and Monroe G. Cheney, of the Anzac Oil Company, will be discussion leader.

About People

André Cournand, associate professor of Medicine, College of Physicians and Surgeons, Columbia University, will deliver the Third Harvey Lecture of the current series at the

New York Academy of Medicine on November 16. Dr. Cournand will speak on "Cardiopulmonary Function in Chronic Pulmonary Disease."

Frank Hovorka, director of the Chemistry Laboratories, Western Reserve University, has been named

chairman of the Division of Chemistry to succeed the late Harold Simmons Booth. Dr. Hovorka has been at the university since 1925.

J. Allen Hynek, of Ohio State University's physics and astronomy faculty, has been appointed assistant

dean of the Graduate School. He will continue on the staff of the Department of Physics and Astronomy, serving also as director of Ohio State's McMillin Observatory and as astronomer at Perkins Observatory, Delaware, Ohio.

Cornelis Willem de Kiewiet, acting president of Cornell University since July 1949, will become the fifth president of the University of Rochester, June 30, 1951. Dr. de Kiewiet succeeds **Alan Valentine**, who resigned last June, and has since been named Administrator of Economic Stabilization.

Five scientists have been added to the staff of the Los Alamos Scientific Laboratory. They are **William W. Wood**, **Carl W. Bjorklund**, **Richard J. Kandel**, **Arthur A. Broyles**, and **Joseph E. Perry, Jr.**

Robert Burns Woodward, professor of chemistry at Harvard University, will give the sixth annual Harrison Howe Lecture before the Rochester Section of the American Chemical Society on November 20. His title will be "Patulin, the Structure and synthesis of a Natural Product."

Visitors

Albrecht Unsold, director of the Observatory and of the Institute for Theoretical Physics, University of Kiel, Germany, was visiting professor of astronomy at Strawbridge Observatory, Haverford College, during October. Dr. Unsold will visit Mount Wilson and Mount Palomar Observatories, the University of California, Yerkes Observatory, University of Michigan, and Cornell University before returning to Germany in mid-December.

The National Bureau of Standards recently received the following visitors: **George D. Coumoulos** and **Alexander A. Trypanis**, of the National Technical University, Athens, Greece; **Charles Massonet**, University of Liège, Belgium; **Konrad Knopp**, University of Tübingen, Germany; **John A. Saxton**, Radio Research Station, Department of

Scientific and Industrial Research, Slough, England; **C. Wainwright**, National Physical Laboratory, Teddington, England; **H. Wouters**, Staatsmijnen (State Mining), Geleen, The Netherlands; **E. R. Cooper**, Dominion Physical Laboratory, Wellington, New Zealand; **M. Gordon** and **C. E. Kendall**, Dunlop Research Center, Dunlop Rubber Co., Ltd., Birmingham, England; **Lord Halsbury**, British National Resources Development Board, London; **H. P. Koch**, British Rubber Producers' Research Association; **A. W. Lategan**, South African Bureau of Standards, Pretoria; **Boyd Mercer** and **S. E. A. Stirling**, Ready Mix Concrete, Ltd., Sydney, Australia; **Hans Oetter**, Feldmühle Papier und Zellstoffwerke Aktiengesellschaft, Oberlahnstein, Germany; **H. C. Richardson**, Gummed Products Pty. Ltd., Sydney, Australia; and **Kenji Saguchi**, Japanese Spinners Inspecting Foundation, Osaka.

George W. Pickering, director of the Medical Unit, St. Mary's Hospital, London, delivered the fourth William Allen Pusey Memorial Lecture of the Institute of Medicine of Chicago on October 30, at a joint meeting with the Chicago Society of Internal Medicine.

Grants and Awards

Research Corporation has announced the allocation of sixty-two grants-in-aid of scientific research, in the fields of physics, chemistry, mathematics, and engineering, to colleges, universities, and scientific institutions in 27 states and the District of Columbia. These awards bring to a total of more than \$700,000 the funds granted during the current fiscal year. New recipients of awards are:

San Diego State College, **Lionel Joseph** and **Robert Isensee**; University of California at Berkeley, **Charles R. Wilke**; University of Southern California, **James C. Warf**; University of Denver, **William C. Stickler**; Yale University, **Harry H. Wasserman**; Florida State University, **Guenter Schwars** and **George Rogosa**; University of Florida, **Edward C. Riets**; Georgia Institute of Technology, **J. M. DallaValle**; Illinois Institute of Tech-

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The **Ford Foundation** has announced the names of the seven universities that will share in a \$3,000,000 grant for the establishment of basic research programs in human conduct. Columbia, Yale, Harvard, California, Cornell, Michigan, and Chicago will each receive \$300,000; \$100,000 each will be given to Minnesota, Pennsylvania, Stanford, Illinois, North Carolina, and Princeton. The foundation is also adding a five-year grant of \$60,000 annually to the Social Science Research Council of New York for similar research, and a grant of \$500,000 to the Public Administration Clearing House of Chicago to further its work in international and national administration.

Three scientists in the field of suprarenal cortex hormones have won the 1950 Nobel Prize for Medicine. They are Mayo Clinic physician **Philip S. Hench**, **T. Edward Kendall**, head of the department of Biochemistry at Mayo, and **Tadeus Reichstein**, of Basel, Switzerland. The citation reads: "For their dis-

coveries concerning the suprarenal cortex hormones, their structures and biological effects." Dr. Kendall, who also discovered throxin, the active substance of the thyroid gland, which has made up for deficiencies in glandular secretion in countless human beings and helped them grow normally, and Dr. Hench, who was the first to apply ACTH in the treatment of rheumatism, were aided in their work by the Research Corporation acting through its Committee on Scientific Research headed by R. R. Williams.

Fellowships and Prizes

The New York State Department of Health is making available one- to two-year fellowships in public health, that provide for residency training, as well as for a postgraduate academic year in a school of public health. The stipend is \$2,400 to \$4,200 a year, depending on the type of training provided. Applicants must be graduates of medical colleges approved by the American Medical Association, or of foreign medical schools recommended by the AMA, and must have completed at least one year's approved internship. They must be eligible for license to practice medicine in New York state and should be interested in, and eligible to enter, public health service in the state upon completion of the program. Applications and further information may be obtained from Dr. Franklyn B. Amos, Director of Professional Training, New York State Department of Health, Albany 1.

Sigma Delta Epsilon, graduate women's scientific fraternity, is offering, for the first time, an award of \$200 to a woman for research done in her own home. The award will go to the woman submitting the best paper describing such original research. It will be presented at the Cleveland meeting of the AAAS in December.

Meetings

The Aeromedical Panel, convened in Washington, October 9, under the chairmanship of Randolph Lovelace

II, head of the Lovelace Foundation, Albuquerque, N. M., and composed of medical scientists from throughout the nation, has completed its survey of medical research facilities, budget, and personnel problems at several major air force installations. Scientists making the survey included John H. Lawrence, Donner Laboratory, University of California, Los Angeles; J. Kaplan, UCLA; Loren Carlson, University of Washington School of Medicine, Seattle; E. J. Baldes, Mayo Clinic, Rochester, Minn.; Donald W. Hastings, University of Minnesota Medical School, Minneapolis; A. P. Gagge, Medical Research Division, Office of the USAF Surgeon General; Magnus I. Gregersen, Columbia University College of Physicians and Surgeons, New York City; Shields Warren, New England Deaconess Hospital, Boston; John B. Hickam, Duke University Medical School, Durham; Paul Morris Fitts, Jr., Aero-Medical Laboratory, Wright-Patterson AFB, Ohio; B. J. Driscoll, Scientific Advisory Board to the Air Force Chief of Staff, Washington; and R. Lee Clark, Jr., University of Texas M. D. Anderson Hospital for Cancer Research, Houston.

Surgical operations televised from an operating room in Grace Hospital to some 1,000 physicians in the Masonic Temple's Crystal Ballroom will high light Detroit's first complete color-television medical seminar, on November 15 and 16. The doctors will view the program through multiple receivers, and, for the first time in medical television, conversation between operator and observer will be possible. The program will be under the auspices of the Wayne University College of Medicine, in cooperation with the Academy of General Practice of Detroit, Wayne County Medical Society, and Grace Hospital. The presentation will be sponsored and directed by Smith, Kline & French Laboratories. A committee under the chairmanship of Charles G. Johnston, professor of surgery at Wayne, planned the program to emphasize clinical subjects, both medical and surgical, of greatest interest to the general practitioner.

NRC News

The American Cancer Society is offering British-American exchange fellowships in cancer research to U. S. citizens possessing an M.D., Ph.D., or Sc.D., for advanced training and experience in Great Britain, in specialized fields pertaining to cancer. Similar fellowships are offered by the British Empire Cancer Campaign to British citizens for study in the U. S. Applications should state the institution where the fellow plans to work, the individual under whom he wishes to work, the problem he intends to investigate, and when he wishes to start. The fellowships will be awarded for one year, effective at the convenience of the institution and the fellow, and carry a stipend of \$4,020. An allowance of \$600 is made for travel to Great Britain, and university staff appointment with teaching duties is permitted. Applications should be sent to the Executive Secretary, Committee on Growth, Division of Medical Sciences, National Research Council, 2101 Constitution Ave., Washington 25, D. C.

NRC Bulletin No. 119, *The Composition of Milks*, may be had without charge from the Publications Office. It was prepared by the Committee on Maternal and Child Feeding of the Council's Food and Nutrition Board, Icie Macy Hoobler, chairman. The report consists chiefly of a complete compilation of the comparative composition and properties of human, cow, and goat milk, colostrum, and transitional milk. Physical properties, fat characteristics, both organic and inorganic chemical components, and vitamin content are given, as well as summary tables and a bibliography.

The first fascicle of the *Atlas of Tumor Pathology* (SCIENCE, January 13, 1950) is now available. The *Atlas*, which is being prepared under the editorial supervision of the Subcommittee on Oncology of the NRC, is a cooperative effort of 30 eminent pathologists, and will be made up of chapters published separately in a loose-leaf format.

The fascicle *Tumors of the Peripheral Nervous System*, by Arthur

Purdy Stout, of the Columbia University College of Physicians and Surgeons, may be obtained for 60 cents from the American Registry of Pathology, Armed Forces Institute of Pathology, Washington 25, D. C. Included is the table of contents of the complete *Atlas* and the introduction explaining the purpose of the entire project—to provide an illustrated and descriptive aid in the teaching of oncology, and a simplification and standardization of the nomenclature of neoplastic diseases.

Deaths

André Gratia, 57, professor of bacteriology in the Faculty of Medicine, University of Liège, since 1932, died on October 6 following a cerebral hemorrhage which occurred while he was vacationing in Switzerland.

Günther Just, professor of human genetics at the University of Tübingen, since 1948, died August 30, at the age of 58, in Tübingen. He was formerly associated with the Universities of Berlin and Greifswald.

Eckhard Rotmann died in August at Köln-Hohenlind after a brief illness, at the age of 43. Formerly a member of Hans Spemann's Institute of Zoology at Freiburg, he was director of the Laboratory for Experimental Embryology of the University of Cologne, Germany.

The former president of the Carnegie Institute of Technology, **Robert Ernest Doherty**, died October 19 in Scotia, N. Y., at 65. Originator of the Carnegie Plan, which requires students to solve specific problems rather than concentrate on texts and lectures, Dr. Doherty more than doubled the Carnegie endowment and carried through major administrative reorganizational programs.

Merritt Lyndon Fernald, 77, Fisher professor of natural history, emeritus, and former director of the Gray Herbarium of Harvard University, died in Cambridge, Mass., September 22. As the leading authority on the flowering plants of eastern North America, he had just completed the monumental rewritten

and expanded eighth edition of Asa Gray's *Manual of Botany*. He was well known to botanists and geologists for his thesis that living plants persisted through the ice age in boreal North America on land exposed above the ice sheets. Professor Fernald was associated with Harvard as student, teacher, and scientist for nearly 60 years.

Recognizing the need "to insure maximum utilization for national defense purposes of our resources of scientists and skilled personnel" and "to maintain our resources of technical manpower as intact as possible," **Lawrence R. Hafstad**, chairman of the government's Interdepartmental Committee on Scientific Research and Development, has just submitted committee recommendations to W. Stuart Symington, chairman of the National Security Resources Board, in an effort to deal with the critical situation. The committee report states that "sure and effective means must be provided to: (a) maintain a continuous flow of young men and women into the scientific professions at least until the shortage of fighting manpower becomes acute; and (b) make optimum use, at all times, of fully trained scientists and engineers in research and development both in the Defense Establishment and in essential civilian activities.

"The Committee believes that the most effective means of meeting these needs is to establish at once a National Scientific Service. This Service should be managed by a board of outstanding men and women, representing the major scientific and engineering disciplines, the military services and other essential fields."

Among the specific recommendations are deferment of professional and practicing scientists and engineers possessing at least a Bachelor's degree or equivalent training in one of the scientific fields, and of skilled technicians; maintenance of the number of science and engineering students "at a level at least equal to the total enrolled in 1949 or 1950"; registration of all scientists and engineers; guidance of the entire pro-

gram of maintenance and utilization of scientific manpower by the proposed National Scientific Service and administration of the program by the National Security Resources Board.

A very limited number of the complete series of *Excursion Guides* from the Seventh International Botanical Congress is available to libraries and botanical institutions until April 1, 1951. Copies remaining after that date will be available to individuals. Price for a complete series, 25 Swedish kronor. A limited number of copies of *Rob. E. Fries: A Short History of Botany in Sweden* are available to libraries, botanical institutions, and to individuals for 10 Swedish kronor. **Communication No. 4** (including the General Program) is available at the price of 2 Swedish kronor. These can be obtained from Dr. Ewert Aberg, Office of the Secretary General, Seventh International Botanical Congress, Uppsala 7, Sweden.

The formation of **Association des Ecrivains Scientifiques** in Paris makes France the fifth country to organize a science writers' association. Set up with the assistance of the Division for the Teaching and Popularization of Science in Unesco's Natural Sciences Department, the new body has as its Président d'Honneur, Prince Louis de Broglie, Secrétaire Perpétuel de l'Académie Française. Chairman of the new association is François Le Lionnais, and André Fortin is secretary.

Applied Mechanics Reviews, formerly edited at Illinois Institute of Technology, has been transferred to Midwest Research Institute, Kansas City, Mo., with Martin Goland as editor. The publication, which presents critical reviews of world literature in applied mechanics, is published by the American Society of Mechanical Engineers, in cooperation with the Office of Air Research, Midwest Research Institute, American Society of Civil Engineers, Institute of Aeronautical Sciences, American Institute of Physics, American Mathematical Society, Society for Experimental Stress Analysis, the Engineering Institute of Canada, and the Institution of Mechanical Engineers, of Great Britain.

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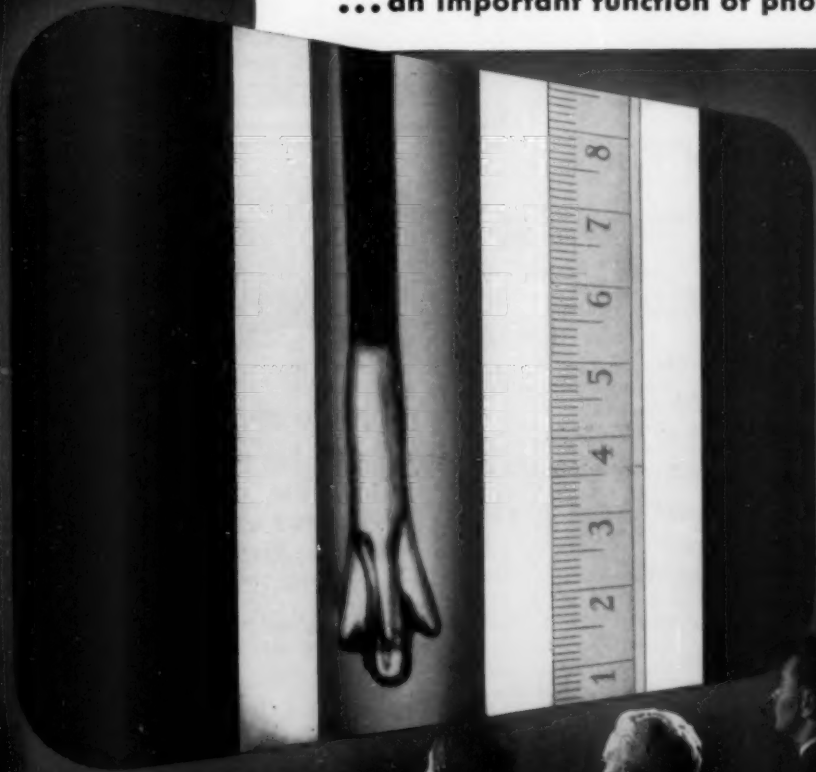
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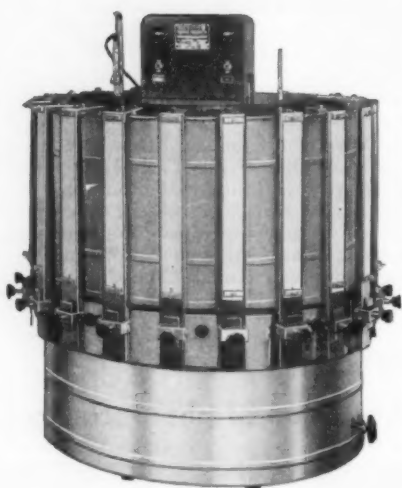
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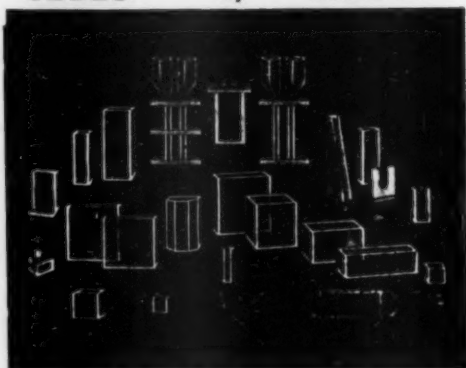
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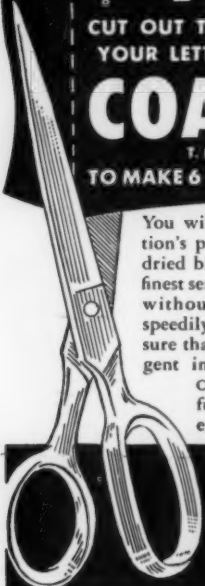
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1. Rate: 15¢ per word, minimum charge \$3.00 for each insertion. If desired, a "Box Number" will be supplied, so that replies can be directed to SCIENCE for immediate forwarding. Such service counts as 10 words (e.g., a 25-word ad, plus a "Box Number", equals 35 words). All ads will be set in regular, uniform style, without display; the first word, only, in bold face type.

For display ads, using type larger or of a different style than the uniform settings, enclosed with separate border rules, the rate is \$16.00 per inch; no extra charge for "Box Numbers".

2. Advance Payment: All Personnel Placement ads, classified or display, must be accompanied by correct remittance, made payable to SCIENCE. Insertion can not be made until payment is received.

3. Closing Date: Advertisements must be received by SCIENCE, 1515 Mass. Ave., N.W., Washington 5, D. C., together with advance remittance, positively not later than 14 days preceding date of publication (Friday of every week).

POSITIONS WANTED

Bacteriologist: M.S. Industrial Bacteriology, B.S. Medical Bacteriology, age 27, desires change. 5 years experience in research and supervising evaluation of antibiotics and chemotherapeutic agents, some experience in pharmacology, virology and as a consultant. Box 330, SCIENCE. R11/10

Bio-Organic Chemist, Ph.D. Experienced in preparation of pharmaceuticals, fine organics; enzyme and protein isolation. Desires responsible work. Box 338, SCIENCE. X

Business Manager and treasurer of large Research Foundation for the past ten years seeks appointment with industrial or academic research group. Experience in all phases of personnel work, accounting, purchasing, maintenance, contract negotiation, and office management. Good contact man capable of meeting the public and understanding the various scientific projects. Box 335, SCIENCE. X

Ecologist: Ph.D., Desires academic or research position in zoology and wildlife. Academic training in zoology, wildlife, and forestry. Four years experience in wildlife research and management with state conservation department in East. Two years experience in mid-west. Box 336, SCIENCE. X

Entomologist, Plant Pathology minor. Ph.D. February. 3½ years teaching experience. Desires teaching-research position. Will be at Denver meetings. Box 339, SCIENCE. X

Mycologist; Ph.D. Excellent background in related sciences. Successful experience in teaching Botany and in industrial research. Desires college teaching, preferably East. Box 334, SCIENCE. X

Psychologist. Clinical. Female. Master's degree. Recently graduated. Desires position in teaching or in field of applied clinical psychology. Box 337, SCIENCE. X

Research Director: Ph.D. (Major: Biochemistry, Immunology; Minor: Organic and inorganic Chemistry); three years, associate professor, pharmacology and toxicology; six years, director of research program related to production of atomic energy; for further information, please write Burneice Larson, Medical Bureau, Palmolive Building, Chicago. X

YOUR ad here will get RESULTS

POSITIONS OPEN

Experimental Physicist or Astronomer: Graduate degree or equivalent experience. Instrumentation work in Solar Astrophysics, Design or engineering experience necessary. Location, Boulder, Colorado. Box 340, SCIENCE. 11/24

Zoology: Ph.D. Man under 35 years of age with experience and permanent interest in teaching elementary Zoology. Opportunity for advancement. Address inquiries to Chairman, Department of Zoology, University of Minnesota, Minneapolis 14, Minnesota. 11/24

Personnel Placement

POSITIONS OPEN

Positions Open:

(a) Physician to become associated with research department of large industrial company; duties research, principally in field of toxicology; advantageous if Ph.D. in one of the sciences; New York City. (b) Neurophysiologist, Ph.D., with extensive experience; physiologist, Ph.D. with minor in endocrinology or pharmacology and, also, two physiologists with Bachelor degrees; research department, new psychiatric unit, large teaching hospital; medical center. (c) Biochemist and biophysicist; newly established radioisotope research and therapy unit; radiochemical experience advantageous; university center; approximate salary levels \$6,000-\$7,500. (d) Eastern university needs Ph.D. to teach pharmacology and, also, Ph.D. to teach bacteriology and pharmacognosy; rank: dependent upon qualifications. (e) Malarialogist; research dealing with malariology and entomological aspects of tropical diseases; foreign assignment; Ph.D. or Sc.D. in medical entomology required, medical degree advantageous. (f) Physiologist or biophysicist; Middle Western college; duties, research and teaching; around \$6500. S11-2 Science Division, Medical Bureau (Burneice Larson, Director) Palmolive Building, Chicago. X

The Market Place

REPLIES ARE STILL COMING IN

to a 20-word classified ad which appeared in November 1948. YOUR ad here will also get results. For "Charges and Requirements", see page 14, Oct. 13th issue.

BOOKS

Send us your Lists of

SCIENTIFIC BOOKS AND PERIODICALS

which you have for sale
Complete libraries; sets and runs; and single titles are wanted
Also please send us your want lists.

STECHERT-HAFNER, INC., 31 East 10th Street, New York 3

Your sets and files of scientific journals

are needed by our library and institutional customers. Please send us lists and description of periodical files you are willing to sell at high market prices. J. S. CANNER AND COMPANY, 909 Boylston Street, Boston 15, Massachusetts. X

WANTED TO PURCHASE:

SCIENTIFIC PERIODICALS

Sets and runs, foreign and domestic

SCIENTIFIC BOOKS

Entire libraries and smaller collections

WALTER J. JOHNSON

125 East 23rd Street, New York 10, N. Y.

LANGUAGES

LINGUAPHONE MAKES LANGUAGES EASY

At home learn to speak Spanish, Portuguese, Italian, French, German, Russian, by quick easy Linguaphone Conversational Method. Save time, work, money. Send for free book today. LINGUAPHONE INSTITUTE, 84-T Radio City, New York 20.

PROFESSIONAL SERVICES

CHEMICAL TYPING

Former expert secretary to top scientists now available as public stenographer and typist. Thoroughly familiar scientific terminology. Standard Rates. FLORENCE GORDON, Hotel Edison (Mezzanine), 228 West 47th Street, New York 19, N. Y. CL 6-5000, EXT. 241. X

FOOD RESEARCH LABORATORIES, INC.

Founded 1922

Philip B. Hawk, Ph.D., President

Bernard L. Oser, Ph.D., Director

RESEARCH—ANALYSES—CONSULTATION

Biological, Nutritional, Toxicological Studies

for the Food, Drug and Allied Industries

48-14 33rd Street, Long Island City 1, N. Y.

Write for descriptive brochure



The Market Place

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THE PANRAY CORP.
Research Division
340 CANAL ST., NEW YORK 13

- Microanalysis (C, H, N, S, Etc.)
- Custom Organic Syntheses
- Chemotherapeutics
- Sponsored Research

TRANSLATIONS of foreign scientific papers and books made at reasonable cost. For rates write to Dr. L. J. PESSIN, P.O. Box 4004, Carrollton Station, New Orleans 18, La. X

Microbiologic Assay • Amino Acids
SHANKMAN LABORATORIES • Proteins
2023 S. Santa Fe, L. A. 21, Calif. • Vitamins

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Cargille CHECK LIST

of
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for

Industrial, Educational and Medical
Laboratories

Second Edition Released November 1950

Write For Your Copy
Just Ask for Leaflet CK-2-S

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New York 6, N. Y.



New Food Ingredients • New Drugs

ANIMAL TESTS

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LaWall & Harrisson

Bacteriologists

Chemists • Pharmacologists Div. S, 1921 Walnut St., Philadelphia 3, Pa.

GLYCOCYAMINE—Hydroxyproline, L-Methionine

- AMINO ACIDS • BIOCHEMICALS
- PRE-MIXED MICROBIOLOGICAL ASSAY MEDIA

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144 North Hayworth Avenue Los Angeles 36, California

White SWISS Mice 20c

Rabbits, Cavies, White Rats, Ducks, Pigeons, Hamsters

Write • J. E. STOCKER • Ramsey, N. J.

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for time-lapse cinematography as used in many well-known institutions, here and abroad, for the study of slow processes. MICRO-CINEMA EQUIPMENT.

ROLAB Photo-Science Laboratories
SANDY HOOK, CONNECTICUT

* Formerly with Dr. Alexis Carrel.



The Market Place

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BELL JARS

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KNOB TOP or OPEN TOP

Skillfully Molded from Perfect Crystal Glass

- Extra-heavy glass walls, carefully annealed to remove internal stresses and strains.
- Precision-ground rims and openings to ensure air-tight fit and to withstand atmospheric pressures when evacuated.

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LABORATORY ANIMALS

- Clean healthy well-fed animals
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- Reasonably priced—Dependable service

DOGS RATS HABBITS
CATS PIGEONS HAMSTERS
MICE POULTRY GUINEA PIGS
JOHN C. LANDIS • Hagerstown, Md.

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STARKMAN Biological Laboratory

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"Your animal is half the experiment"

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ALBINO - W RATS

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RED BANK, N. J.**

All Amino Acids (natural, synthetic, unnatural), Rare Sugars, Biochemical Products, Reagents, New Pharmaceuticals in stock. Write or phone PLaza 7-8171 for complete price list.

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Equipment for Photomicrography

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New York 18, N. Y.**

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for the Cleveland Meeting of the AAAS

**AVOID CONGESTION AND DELAY
GET YOUR GENERAL PROGRAM –
BY FIRST CLASS MAIL – EARLY IN DECEMBER**

Registration in *advance* of arrival at the 117th Annual Meeting of the AAAS in the downtown hotels of Cleveland, December 26–30, 1950, has so many advantages that we wonder why almost *everyone* doesn't take this simple step. For instance:

1. You avoid congestion and delay at the Registration Desks in busy foyers at time of arrival. All indications point to a large attendance since all of the Association's seventeen sections and subsections, and more than forty societies, will have sessions with excellent programs and there will be a number of important symposia.
2. You receive the General Program early in December in ample time, unhurriedly to decide among the events and the sessions that you wish to attend.
3. Your name and hotel address will be in the enlarged Visible Directory the first hour of the first day of the meetings, since it will be posted in Washington as soon as processed.
4. Advance Registrants will have the same privileges of receiving a map and directory of points of interest of Cleveland, literature, radio broadcast tickets, etc. At the convenience of Advance Registrants, these will be distributed from the Main Registration in the Public Auditorium—the location of the Annual Science Exposition, the Visible Directory, and the Science Theatre. Admission to the splendid series of latest scientific films will be free to all Registrants.

At the 1949 Meeting, the Council of the AAAS voted overwhelmingly to continue Advance Registration. To insure its prompt receipt, the General Program will be sent by *first class mail* December 1–4, 1950—which is also the *closing date* for Advance Registration.

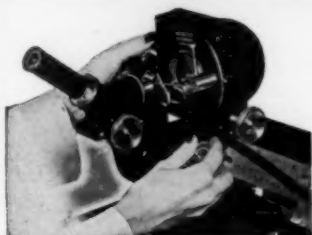
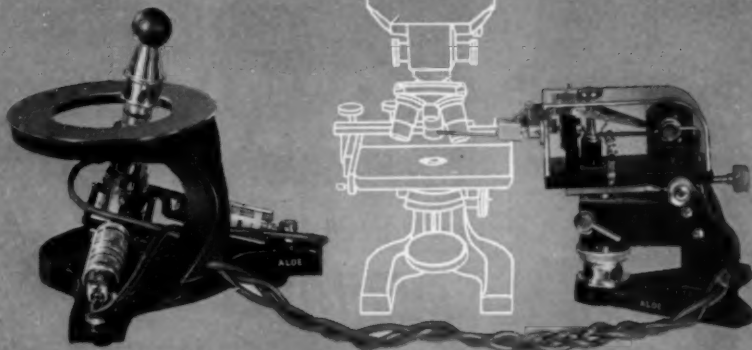
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☐ \$2.25 A.A.A.S. Member (check one) ☐ \$2.25 College Student
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2. FULL NAME (Miss, Mrs., Dr., etc.) _____
(Please print or typewrite) (Last) (First) (Initial)
3. ACADEMIC, PROFESSIONAL, OR
BUSINESS CONNECTION _____
4. OFFICE OR HOME ADDRESS _____
(For receipt of Program and Badge)
5. YOUR FIELD OF INTEREST _____
6. CONVENTION ADDRESS _____
(If not known now may be added later)
7. DATE OF ARRIVAL _____ DATE OF DEPARTURE _____

Please mail this Coupon and your check or money order for the fee, \$2.25 or \$3.25, to
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Now manufactured in America under exclusive rights to the de Fonbrune French patents, this new Aloe Pneumatic Micromanipulator brings to micro-biological and micro-chemical analyses a simplicity of operation and a flexibility of application not possible with any other equipment. The receiver permits use of a variety of micro-instruments under low power wide field, dry or oil immersion objectives. It also permits experimentation on cells by electric current.

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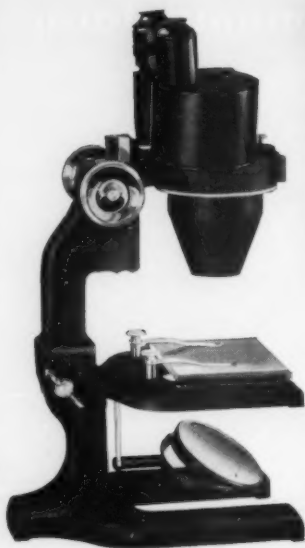
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